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TEXTILE RESEARCH

VOLUME XV January, 1945 NUMBER 1

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TEXTILE RESEARCH

VOLUME XV – 16 January, 1945 NUMBER 1

1945-1946

Some Applications of Microscopy to Cotton Research

T. L. W. Bailey, Jr., and Mary L. Rollins

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In the study of textile materials—fibers, yarns, plies, cords, and fabrics—the microscope is a most valuable tool. With this instrument and accessory equipment it is possible to study dimensions, shape, color, structure and markings, other physical properties, and behavior toward chemical reagents, and to obtain a more exact understanding of the effects of any treatments applied. Control tests with the aid of the microscope, made during the development of a process, assist the investigator in modifying his methods to attain a specific end.

At the Southern Regional Research Laboratory the microscope is being employed in the study of improvements in wartime cotton products. Since individual fibers are often affected by treatments used to alter the characteristics of yarns or fabrics, it is necessary to consider the variability and the range of magnitude of the physical properties, including fineness, length, and shape, of the raw fibers. This information serves as a basis of comparison for the changes brought about by various treatments.

A cotton fiber is a single cell many times as long as it is broad; when examined under the microscope it appears as an irregularly twisted and collapsed or flattened tube with a central canal or lumen. To illustrate clearly the relationship of length to breadth, a single Sea Island fiber, 2¼ inches long, was coiled about itself and photographed (Figure 1). The length of this fiber is approximately 3,600 times its width. The flattened cotton fiber exhibits a very great range in width from base to tip. The body of the fiber is characterized by a thickened wall and a

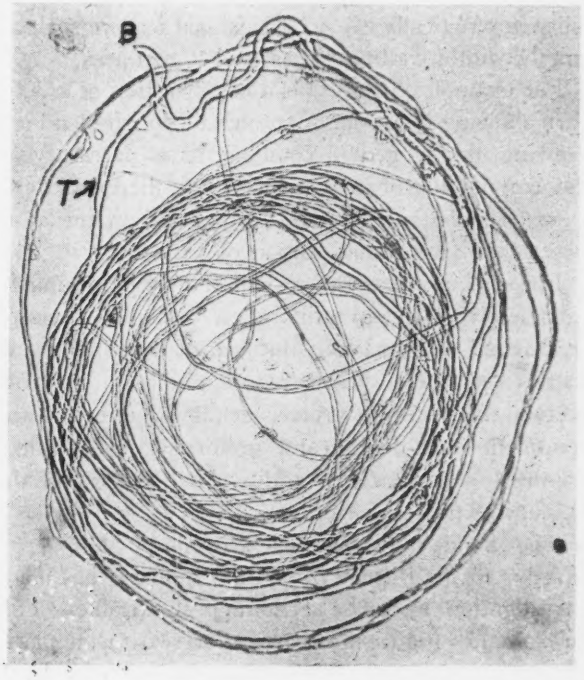

FIG. 1. *Portrait of a complete single fiber of Sea Island cotton. B—Base. T—Tip. Magnification 60 X.*

[1] One of the laboratories of the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, U. S. Department of Agriculture.

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central canal. The spirals or convolutions are distinct twists about the longitudinal axis of the fiber with the helix frequently reversed. The tip of the fiber is tapered and lacks both lumen and convolutions. In cross section the cotton fiber may be circular, elliptical, or linear. While the general geometric shape for the most mature fibers is elliptical to circular, less mature fibers are rectangular with rounded corners, and immature fibers are often so

FIG. 2. *Cross section of a 300s yarn. Magnification 500 ×.*

completely collapsed that in cross section the lumen shows only as a line.

A striking characteristic of any given sample of cotton, whether raw or processed, is the great variability in practically every dimensional feature such as length, width, wall-thickness, and lumen area.

For example, Figure 2 is a cross section of a 300s yarn showing that even after such thorough blending, drawing, doubling, and combing, as is necessary in the manufacture of yarn of this count, there still exist extreme variations of size, shape, and maturity of fibers in a given cross section of yarn.

For certain investigations, fibers may be examined satisfactorily in longitudinal view to show effects of treatments—for instance, the lack of convolutions in mercerized fibers. However, examination in cross section will show in greater detail the effect of the treatment—the degree and uniformity of swelling, depth of penetration of additive materials, and the amount of fiber deformation.

The hand microtome developed by Dr. J. I. Hardy [2] of the Bureau of Animal Industry has made investigation by cross-sectioning practicable. This microtome (Figure 3) consists of two metal plates whose edges are held in alignment by grooved pieces. One plate is slotted down the center to receive the fiber bundle; the other is made with a tongue for forcing the fibers down to the base of this slot. When the two plates are fitted together, tongue into slot, they form a single unit having the size and shape of a microscope slide. Fibers combed parallel for sectioning are inserted into the slot before the plates are pushed together. After the protuding ends of the fibers have been cut off flush with the metal on each side, an auxiliary plunger, which snugly fits the slot, is mounted upon the slotted plate by means of a small screw. The plunger is moved by a fine propelling screw, so that a partial turn of

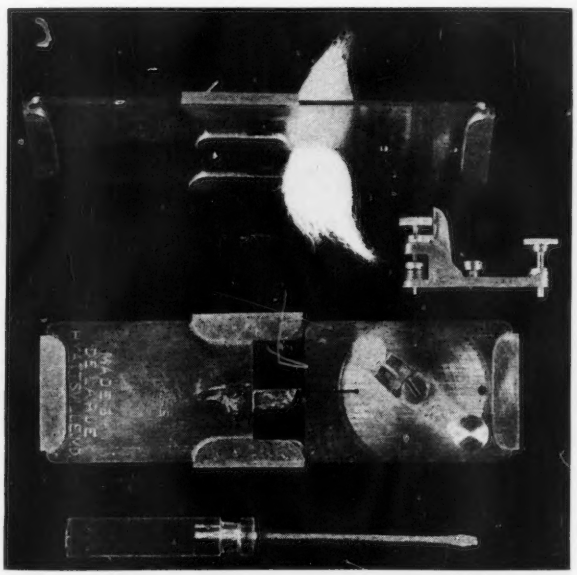

FIG. 3. *Hardy thin-sectioning device. View shows preliminary steps in loading with fibers; auxiliary screw detached. Lower view shows detail of slot opening. Approximately natural size.*

the screw will push the fibers a few microns beyond the surface, where they may be sliced off with a safety-razor blade. A thin coat of collodion is applied to cement the fibers together before each slicing is made. The thin sections thus cut are mounted in mineral oil, or some suitable mounting medium, on a microscope slide.

This handy microtome has been used for some years in the study of the cross-sectional features of wool, cotton, and other fibers.[3] In this laboratory

[2] J. I. Hardy, "A Practical Laboratory Method for Making Thin Cross-Sections of Fibers." Circular 378, U. S. Department of Agriculture, 1935.

[3] Karrer, Enoch, and Bailey, T. L. W., Jr., "Geometric Fineness of Cotton Fibers and Associated Cross-Sectional Features: Their Comparison by Means of Graduated Scales," TEXTILE RESEARCH **8**, No. 11, 1938.

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it has been used also for the sectioning of fabrics to show warp and filling yarns in their natural positions, to show the effects of various special finishing treatments on fabrics, and to permit the identification of the kinds of fibers in a fabric. For all but the thinnest of cloths, it is necessary to employ a device with a somewhat larger slot than the one used for bundles of fibers. Cellophane film is used to build up the thickness of thin samples so as to make a snug fit. The strips of cellophane may be easily removed from the sections with needles while they are being mounted. The mixed-fabric section (Figure 4) was prepared so that the rayon fibers of the filling yarn were cut in cross section and the dyed cotton fibers of the warp were split longitudinally.

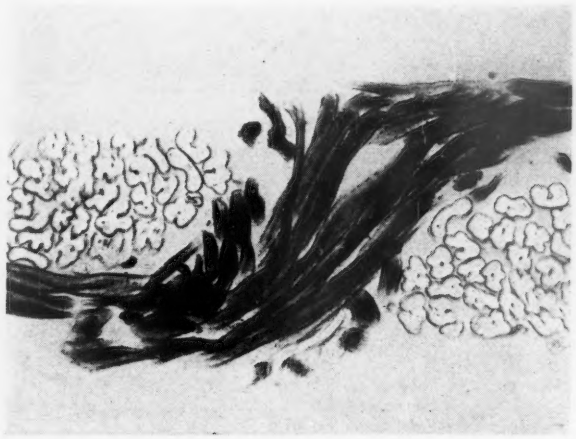

FIG. 4. *Cross section of a mixed fabric—the rayon (acetate) filling yarn in cross section, and the dyed cotton warp yarns split longitudinally. Magnification 250 ×.*

To accomodate yarn or cord, a device similar to the Hardy model was made with a circular opening at the base of the slot and a cylindrical plunger to propel the cord (Figure 3). In using this device, the sections are coated with collodion, in the usual manner, before each slicing. To prevent distortion of the cord or yarn, and at the same time to hold it firmly, a group of easily distinguishable alien fibers are fitted about the specimen in the slot.

Dyeing and staining techniques may be used to good advantage in studying the penetration of additive materials such as preservatives for rotproofing, water-repellent coatings, and special finishes. Usually, such materials are transparent and not easily observed in thin sections unless they are colored. Selective dyes or stains may thus be used to show the location of the coating material. In the case of certain chemical treatments, the dye or stain is absorbed by the treated fibers; the untreated fibers are easily distinguishable since they remain unstained.

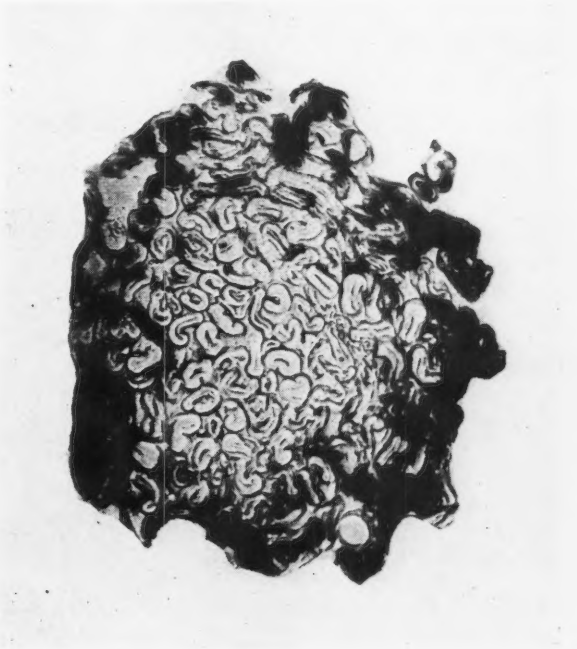

FIG. 5. *Cross section of single yarn stained to show starch sizing. Magnification 250 ×.*

In Figure 5 the starch sizing on a cotton yarn has been stained with iodine to demonstrate the distribution of starch on the surface of the yarn.

Figure 6 shows a sample of cotton yarn which has been subjected to an acetylation treatment. When dyed with an acetate dye, the more affected fibers took on a dark coloration whereas the fibers that were not so greatly affected by the process remained white. The incompleteness of the acetylation in this particular instance is revealed.

Figure 7 shows the outer fibers in yarns fused by sulphuric acid to give to the fabric a parchmentized finish similar to "permanent starching." This treatment is sometimes used for producing an organdy finish. The deformation of fiber shapes by a combination of chemical and physical treatments of a cord is shown in Figure 8 where the abnormally angular peripheries and the straight-sidedness of the cotton fibers testify to the severity of the treatment undergone by the yarn. (*Continued on next page.*)

The properties of fabrics and cords can be considerably altered by impregnation with chemical compounds. Rotproofing, mildew-proofing, fireproofing, and moistureproofing of fabrics have important connection with the maintenance of supplies for the armed forces. They are essential for tents, sandbags, airplane covers, and canopies. Microscopic examination of sections of treated fabrics for degree of impregnation, and for comparison of various experimental impregnations in regard to depth and uniformity of penetration, is of value in the interpreta-

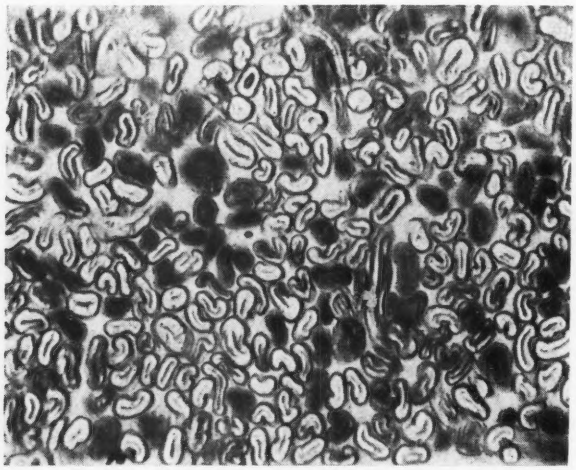

FIG. 6. *Cross section of sample of acetylated fibers; darker fibers most affected; white fibers less affected. Magnification 250 ×.*

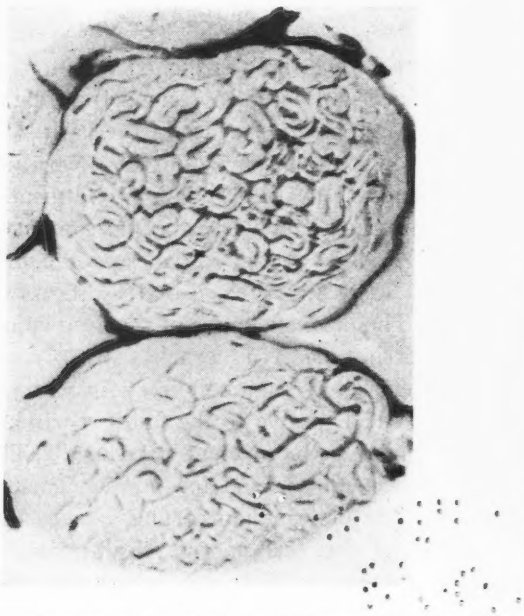

FIG. 7. *Cross section of chemically treated yarns for special fabric finish. Note fused material around the edge of each yarn. Magnification 250 ×.*

FIG. 8. *Cross section of fibers showing deformation of fiber wall. Note straight edges on many of the fibers. Magnification 500 ×.*

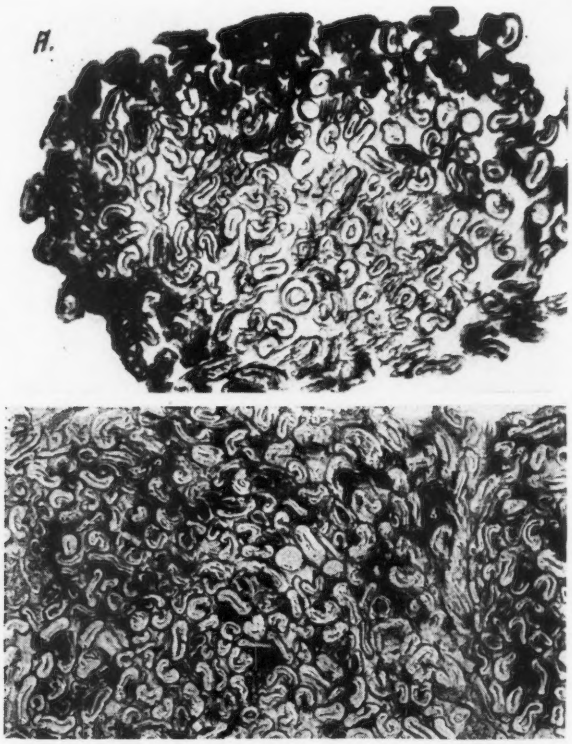

FIG. 9. *Cross section of yarn showing penetration of preservative for rotproofing. (A) Superficial penetration. (B) More complete penetration. Magnification 250 ×.*

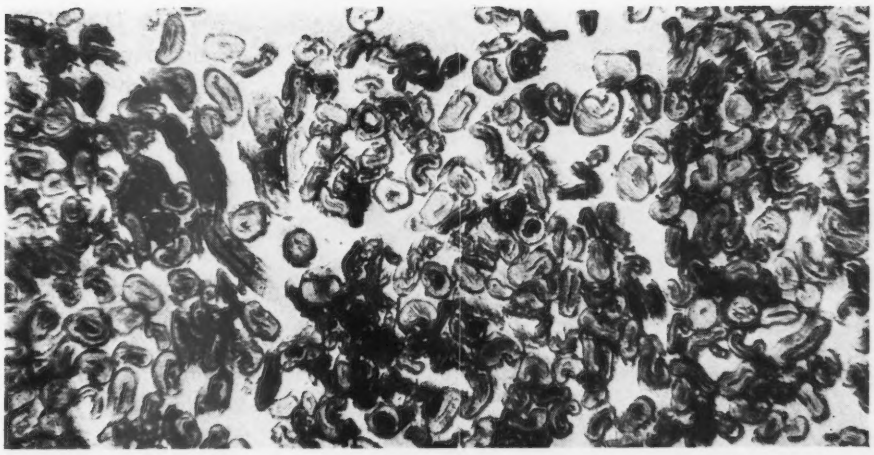

FIG. 10. *Cross section of fibers from a sample which shows resinification in the walls of the cotton fiber and in the lumen. Magnification 250 ×.*

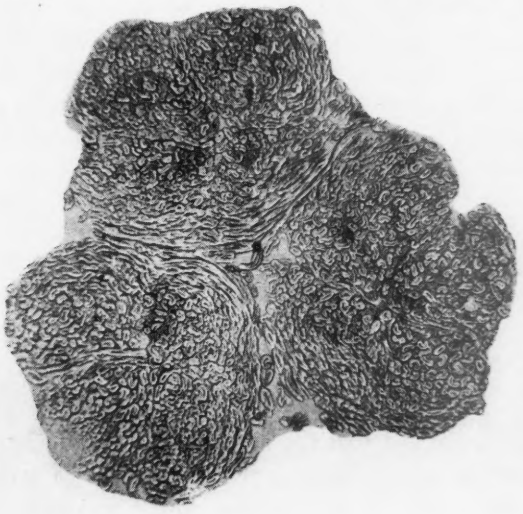

FIG. 11. *Cross section of low-gage cotton tire cord—22/4/3. Unstretched. Magnification 125 ×.*

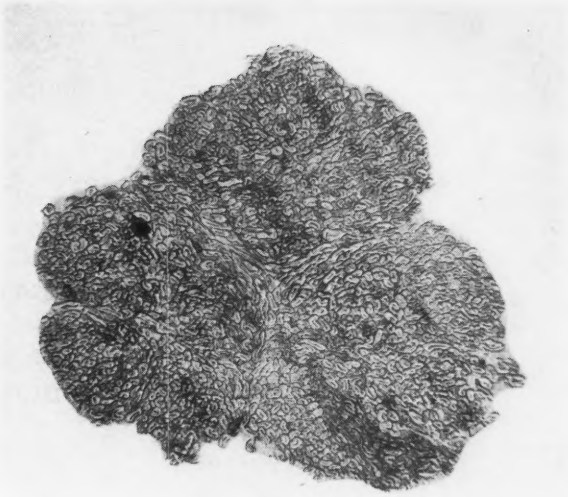

FIG. 12. *Cross section of low-gage cotton tire cord—22/4/3. Wet-stretched. Magnification 125 ×.*

tion of specific chemical processes. Figure 9 shows the penetration of a cotton yarn with a fungicidal compound. In (A) the compound is merely on the outer edges of the yarn and little has penetrated between the fibers; in (B) the material has been forced into most of the voids between fibers, insuring the protection of individual fibers. Although (A) and (B) contain approximately equal amounts of preservatives as determined by chemical analysis, (A) is not rotproof, while (B) is. In this case, microscopical examination is more revealing than chemical determination. Resin treatment of sandbag fabrics is most permanent when actual polymerization of the resin occurs within the cell wall of the fiber. Figure 10 shows that such an experimental rotproofing treatment has caused resin to be deposited in the walls and lumen of the fibers. Note particularly that the lumens of some of the fibers are completely filled.

Recently the relative merits of cotton and rayon fibers for tire cord have been discussed at length. With the use of the microscope and special techniques, a detailed comparison of different types of cord can be made, and the effects brought about by different treatments can be accurately observed.

Cross sections will reveal the changes resulting from physical and chemical treatments during the manufacturing processes, such as wet-stretching, emulsion coatings, twist combinations, and other treatments.

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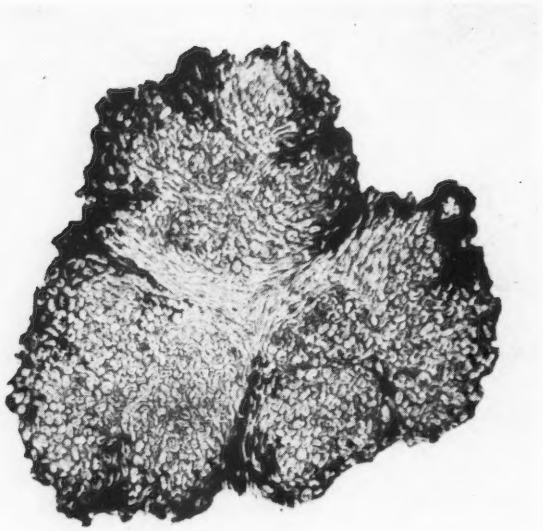

FIG. 13. *Cross section of cotton tire cord. Black portions represent rubber adhering to cord. Magnification 125 ×.*

Figures 11 and 12 show the difference between an ordinary tire cord and one that has been "wet-stretched." The "wet-stretching" process has brought about compactness of both fibers and yarns. Figure 13 shows the depth of penetration of rubber into a tire cord. This specimen was removed from a new tire of standard make. No precoating was used to increase adhesion, and all of the black material shown about the edge of the cord represents rubber deposited during the tire-manufacturing processes.

A method of serial sectioning along the length of a cord has been successfully employed in the study of the intimate contact of fibers in yarns, plies, and cables. The relationship of these structural units one to another, as well as alterations due to mechanical treatments, have been studied by this method. Cords for such investigations are composed of different colored plies; in this way, fiber alignment of individual singles and of plies may be easily followed. Further application and extension of longitudinal sectioning is now in progress.

The New Format for Textile Research

THE changed appearance of this issue of TEXTILE RESEARCH is one step in the evolution of a plan for further improvement of the Institute's journal as a technical and scientific publication devoted to the interests of textile research. The increased page size will facilitate the arrangement and use of text, tabular material, and illustrations. Greater ease of reading has been sought in the choice of type used.

Research papers will be carried in full in the journal and, in order that a high standard of content may be maintained, papers submitted for publication will be accepted only after having been reviewed and approved by competent reviewers.

Research of a fundamental nature as well as that dealing with specific applications will be reported and as wide a distribution of subjects as possible will be carried. Informative articles of general interest will appear occasionally, also important news items and book reviews.

It is planned that the abstract section will be expanded to give a more complete coverage of articles of importance to textile men which appear in the current literature and to include references to new patents. The value of the limited coverage that previously has been carried in this section has been proved by the response by readers of TEXTILE RESEARCH to the recent offer by the Institute to furnish reprints of the abstracts printed on one side of the page in order that they may be conveniently clipped and filed for reference. Subscriptions to this service are still available at $2.50 for the year 1945.

Every effort will be made toward continued improvement of the journal and to increase its usefulness as a medium for bringing to the industry research information of value not only for immediate use but also for permanent reference. To this end the editor will appreciate constructive suggestions.

The Growth Factor in Small Business

Earl P. Stevenson

The following article by Earl P. Stevenson, president of Arthur D. Little, Inc., will be of interest to many of our members. It is a paper which was delivered by Mr. Stevenson at a Forum on the Future of Industrial Research sponsored by the Standard Oil Development Company in connection with the recent National Chemical Exposition held in Chicago. A complete reporting of the papers delivered at this forum appeared in Chemical and Engineering News, *October 25, 1944.*

In our zeal for generalization and over-simplification we speak of small and large corporations and attempt to fit all industrial enterprises into one or the other category. Yet no criterion justifies a sharp line between these two groups, even though we can agree on the proper category for almost any one company. Among the criteria often applied is capitalization [1],[1] and here the twilight zone might be fixed as between $1,000,000 and $5,000,000.

Given the question, how can small business serve itself and be served by industrial research and development, gross sales is a more useful figure for defining our subject. Size, however, affords no measure of the extent to which a company should support research, as both opportunity and necessity vary widely with different kinds of enterprise. The 1940 survey of the location and extent of industrial research activity in the United States shows clearly that, although a substantial number of small and medium-sized corporations engage in research, their total effort is relatively small. The bulk of industrial research is supported by comparatively few large corporations [2].

It is characteristic of smaller companies that their research activities are not set apart in a functional unit. The individual in charge of a company's research activities will have other administrative responsibilities; those engaged directly in the work itself may have other duties. The research activities of small companies tend naturally to be individualistic. Research may center in a close group of technically trained operating executives or in one inventive type of individual. These widely varying circumstances are a major factor in determining the relations of the professional research organization to small industrial enterprises.

There is some misunderstanding as to the size of company which employs the services of the research consultant. Although it is dangerous to generalize from one example, I venture the opinion that the situation of other research consultants is not unlike that of Arthur D. Little, Inc. Our clients are found largely among the medium-sized ($1,000,000 to $10,000,000 capitalization) and the large corporations. By number, possibly 20 percent of our clients are small companies, and from these we derive less than 5 percent of our current income from professional services.

As recently pointed out by Fairfield E. Raymond [3]:

> "The small enterprise has the option of carrying on whatever sort of research it can afford, of developing its own technicians and experts, of acquiring new knowledge by hiring trained engineers, or by participating in professional-society activities, by paying for the services of consultants or scientists, by financing specific research projects through technical institutions, or by buying outright new technical developments or inventions from individuals or other companies."

A company must make a judicious choice between these several options. With changing conditions a company so situated would be expected to shift its policy from time to time as necessity dictates.

My own experience confirms Raymond's finding as to the intermittent and irregular use of the preceding resources. The reason is to be found in the

[1] Figures in brackets indicate literature references at the end of this paper.

limited means of the small company for the support of any sustained long-term research effort. While the percentage of gross sales spent by small concerns varies quite widely, according to recent surveys [4], 2.5 percent of gross sales appears to be an average figure. A conservative company adhering to the average and with a million-dollar sales may be expected to have a research budget of $25,000 a year. In order that this budget may be used effectively the company must allocate a major part to immediate organizational expense, for, as pointed out in an earlier paper [5], the services of a research consultant and related agencies are seriously handicapped if the client does not have on his own staff at least one individual competent to participate in the work and to see that the findings are intelligently and usefully applied.

It is becoming increasingly necessary for the small company to support a technical staff, and it is from these expenditures that it may expect to receive the highest return. Such a group can participate with benefit in the activities of the scientific and technical societies related to the company's industry, in the use of technical data published by the technical and scientific societies and government laboratories, through contacts with educational institutions, and through the assistance of large industrial research organizations that are back of the materials used by the company. As a matter of fact, such representatives of small industry are constantly calling upon the research consultant and thus availing themselves of the somewhat institutional position of such organizations. In other words, there is greater participation in the activities of small companies than would be indicated by the figures which I have cited in the case of Arthur D. Little, Inc.

Mention should be made at this point of the services rendered by individual consultants. As a group they may be more adaptable to the intermittent and informal relations required by small companies than are the larger engineering and research institutions. A few years ago the combined Engineering Societies of New England published a directory of "the New England research agencies, consulting services, and colleges and universities available to New England's industrial, commercial, and other interests for the solving of their problems by the practical application of the research method" [6]. Over 500 institutions and individuals are listed. This extensive list is indicative of the great reservoir of technical advisory and cooperative service available throughout the industrial section of the country, but all too little used by small business.

How to make effective use of this reservoir has been accepted in New England as a challenge. In the fall of 1941 a plan was formulated to assist small industries in their use of research methods. The New England Council with its large membership among all sizes and kinds of businesses was the leader of the project. The situation in New England was surveyed under a committee headed by Karl T. Compton, president of Massachusetts Institute of Technology [7]. From this developed the New England Industrial Research Foundation, with its major purpose the promotion and utilization of research methods by New England industry, both large and small, but with the needs and problems of the latter a particular objective.

The outstanding conclusions which I have drawn from participation in the administration of this foundation from its inception are: (1) that there is a widespread and intelligent interest in research by business executives in small companies; (2) that more funds are available than are being spent; (3) that opportunities for research and development are recognized; (4) that the missing element is in technical and scientific manpower. The program of the foundation can only be implemented by making men available to meet the needs of the progressive small business. In the absence of such help the foundation has largely curtailed its activities for the duration of the war.

The office of the New England Industrial Research Foundation has received inquiries from other industrial areas, and I have no doubt that in the post-war period a number of organized centers facilitating the use of available research aid will be established primarily for the benefit of the small manufacturer. Several states already have annual industrial conferences devoted to the application of research.

Importance of Technical Training

If I were asked to suggest specific steps that would aid small industry in the use of research in the immediate future, I would first discuss the matter of employment of men who speak the research man's language—men trained in our great technical educational institutions. It is not sufficient for the business executive to be sympathetic toward research; he must also have an understanding of its techniques and the ability to select the right kind of men.

It is evident from the record that large companies hire most of the technical men. Experience in this respect at the Massachusetts Institute of Technology is believed typical of the better technical schools, and it shows that the large companies have studied the competition in their technical graduate supply market, and that they compete seriously and effectively for a continuing flow of young technical graduates into their organizations. Not so the small companies. Obviously, they have not recognized or realized the need, or have not studied the competition they must meet, for relatively they are not adequately represented in the technical graduate markets each year. It is not that they cannot meet the competition, for the small company appeals to many men merely because it is small, and the small company is much more flexible in the special salary or other conditions it can establish. The relatively few small companies that make a special effort to obtain technical graduates on a competitive basis have found no insurmountable difficulties.

It must be recognized, however, that the large industrial research organization has much to offer the young graduate: pleasant associations that continue earlier friendships, the opportunity to work in fields of specialized scientific interest, the glamor of belonging to a nationally known organization, the promise of early advancement with financial and social security. Also in certain educational fields, notably chemistry and chemical engineering, the leading graduate schools have a definite vocational relationship toward the established manpower requirements of the large industrial research organizations.

An analysis of the list of large companies that maintain the bulk of our research and hire the bulk of our technical men is most illuminating. A major portion of them are found to have started with technical development, to have been built on research and engineering. The names of the great companies with their great laboratories in the electrical, petroleum, chemical, and process industries immediately suggest themselves. They do not hire technical men because they are large—they are large because they hired technical men when they were small and have kept on hiring technical men. By contrast the railroads, the coal industry, and other industries are large, but they are not relatively good markets for our technical graduates nor have they yet been relatively large supporters of research. The outstanding industries supporting research and hiring our technical graduates year after year are chemicals, petroleum, and the electrical group. The chemical and electrical industries grew from research and the use of technical men. The most spectacular increase in the employment of research personnel in industry in the period between 1927 and 1938, charted by Cooper, was in the petroleum industry. In that period the petroleum industry joined the ranks of those who know how to use research wisely and generously and, as a result, the industry prospered greatly and the public profited enormously.

Obtaining Technical Personnel

Many small companies, if they are to compete and assuredly if they are to grow, must learn first to compete for technical personnel. If competent technical personnel is intelligently absorbed and utilized, effective research will follow almost automatically. There are ample facilities available for advice, consultation, and direct and continuing assistance. Organized bodies, like that sponsored by the New England Council, exist or are being created to facilitate the use of such assistance. Most small companies are probably aware of the significance of research, but many of them are still unaware of the methods by which research can be utilized within their budgets and their organizational structure. The need now is not for more sources of assistance or free service—research bread lines—the need is rather for education of small-company management in the advisability of employing technical personnel and in methods of utilizing research assistance now available. These needs, unfortunately, are still great, and in this area of society ours is an economy of scarcity.

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2. *Ibid.*, Sec. IV, pp. 182–3.
3. *Ibid.*, Sec. II, p. 79.
4. *Ibid.*, Sec. II, p. 124.
5. Stevens, Raymond, and Stevenson, E. P., *Chem. Eng. News*, **21** 1869 (1943).
6. Engineering Societies of New England, Inc., in cooperation with the New England Council, "Directory of New England Research and Engineering Societies" (1939).
7. "Industrial Development in New England," an address delivered before a joint meeting of New England Council and AAAS at University of New Hampshire (1941).

Condensed Charts for Sliver Tester

C. H. Plummer

A Contribution of the Research Division, Chicopee Manufacturing Corp.

THE modifications made by Chicopee Manufacturing Corporation on the Saco-Lowell Sliver Tester were outlined and discussed in a recent issue of TEXTILE RESEARCH.[1] Among these modifications were additional provisions for a greater range of chart speed and Figure 1, illustrating the sliver tester, shows the additional change gear mechanism on the chart drive. The original chart speeds available gave a ratio of sliver to chart of 1:1 and of 12:1 and the additional gearing provides for ratios of 144:1 and 1728:1. The slowest chart speed, accordingly, condenses the record of 1,728 yards of sliver on to 1 yard of chart.

These changes have greatly extended the utility of the sliver tester for research purposes. Considering a one yard length of chart a convenient size for analysis, it is now possible to represent the characteristics of a complete can of sliver utilizing the 1728:1 chart speed ratio in this length. This brings us into a new field of testing and allows us to analyze changes in linear density taking place throughout whole cans of sliver as well as in shorter lengths.

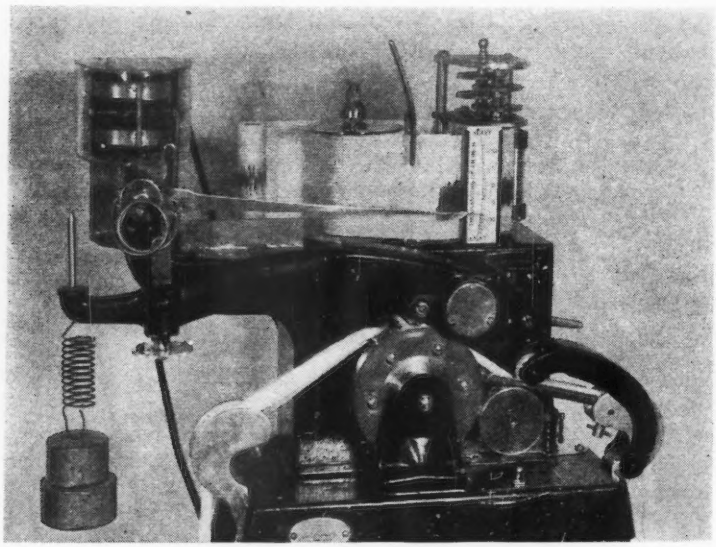

FIG. 1. *Saco-Lowell Sliver Tester as modified by Chicopee Manufacturing Corp.*

Drawing Sliver

Figures 2 and 3 are records made from poor and normal drawing sliver respectively, and provide a contrast between good and poor drawing. Charts "A" were made using a chart speed ratio of 1728:1, and portray the characteristics of nearly a whole can of drawing sliver in the length of chart illustrated. The average size of the sliver and the percent standard deviation of its linear density have been calculated for each consecutive length group as indicated and the results are shown directly on the record. Similarly, the total average size and total percent standard deviation of linear density have been calculated and noted.[2] Charts "B" were made using a chart speed ratio of 144:1 and the linear density characteristics of approximately 73 yards of sliver are illustrated in the length of charts shown. The linear density characteristics of 8 yards of sliver are shown in the length of chart made with a chart speed ratio of 12:1 and marked "C."

At this point, it is interesting to note that the charts marked "C" are the most condensed records available using the standard sliver tester. For comparison, 12 inches of chart "C" have been condensed to 1 inch on chart "B," and, similarly, 12 inches of chart "B" have been condensed to 1 inch on chart "A."

In analyzing the linear density characteristics of drawing sliver, charts "B" and "C" are normally used. There is very little, if any, long period density irregularity in drawing sliver that is not evident on chart "B." A comparatively short period density irregularity is characteristic of drawing sliver and it is the amplitude of this variation that one is normally interested in studying. Charts "B" of

[1] "Vibration in Textile Testing Devices," TEXTILE RESEARCH **14**, 76–9 (March, 1944).

[2] An article will follow shortly on the methods for quantitatively evaluating these charts.

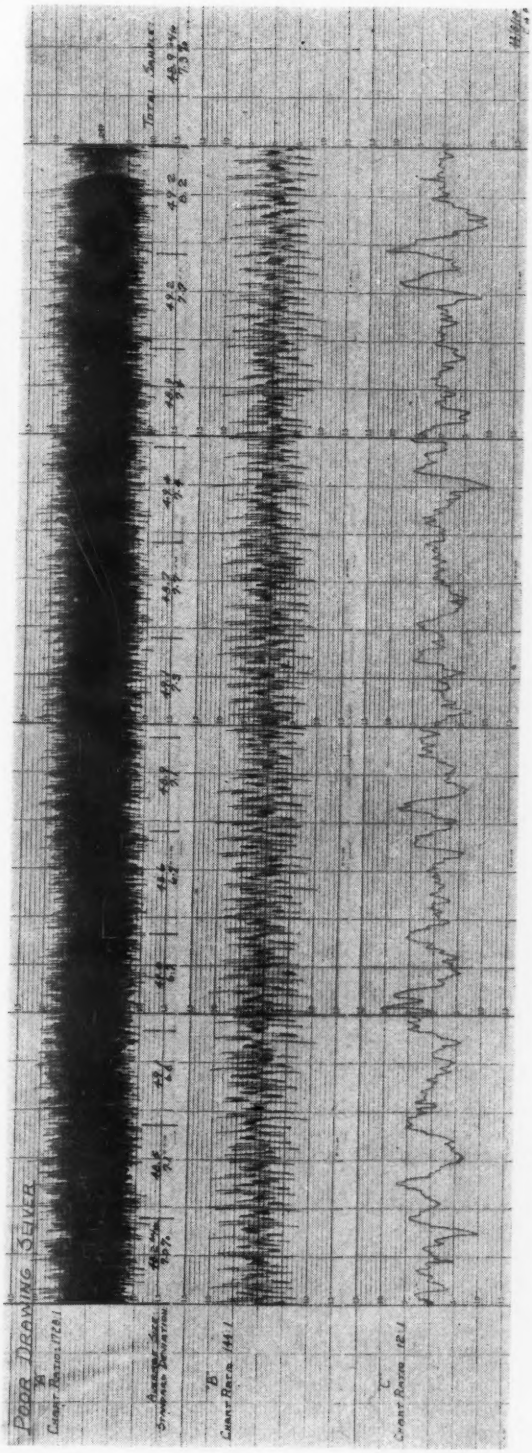

FIG. 2. *Record made from poor drawing sliver.*

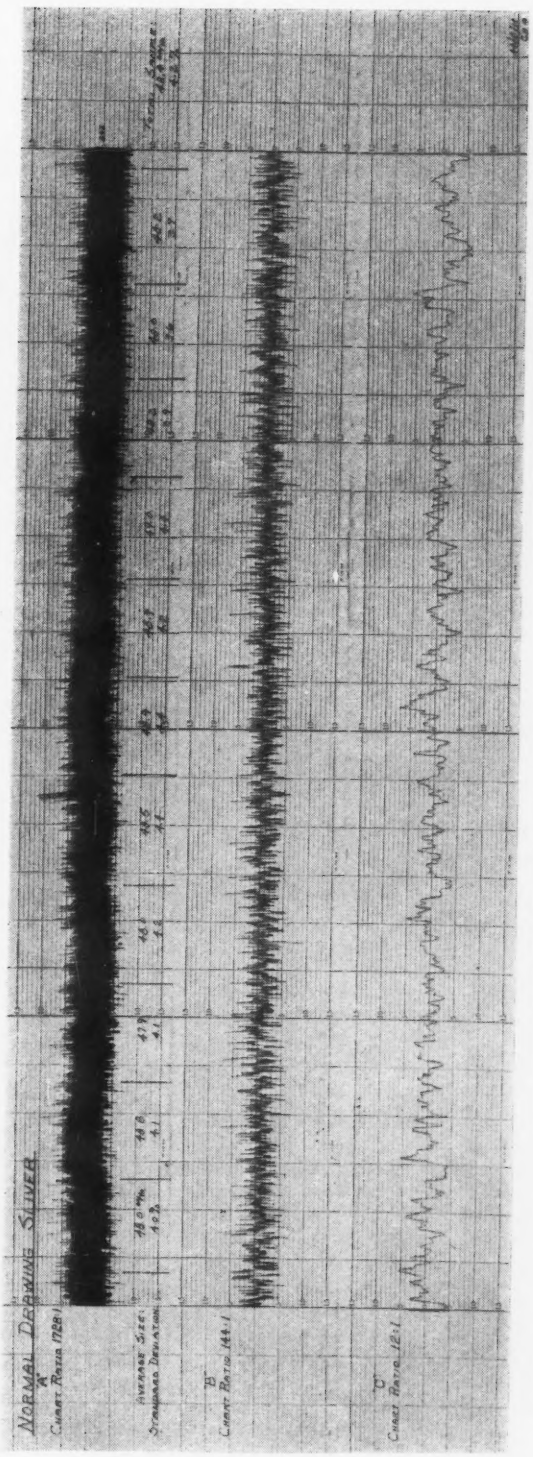

FIG. 3. *Record made from normal drawing sliver.*

Figures 2 and 3 immediately indicate a difference in the amplitude of this short period variation. For a further analysis of the wave lengths of this variation as well as any other peculiarity of the variation, chart "C" is usually employed which is a more extended record of "B" and is easier to analyze for this pur-

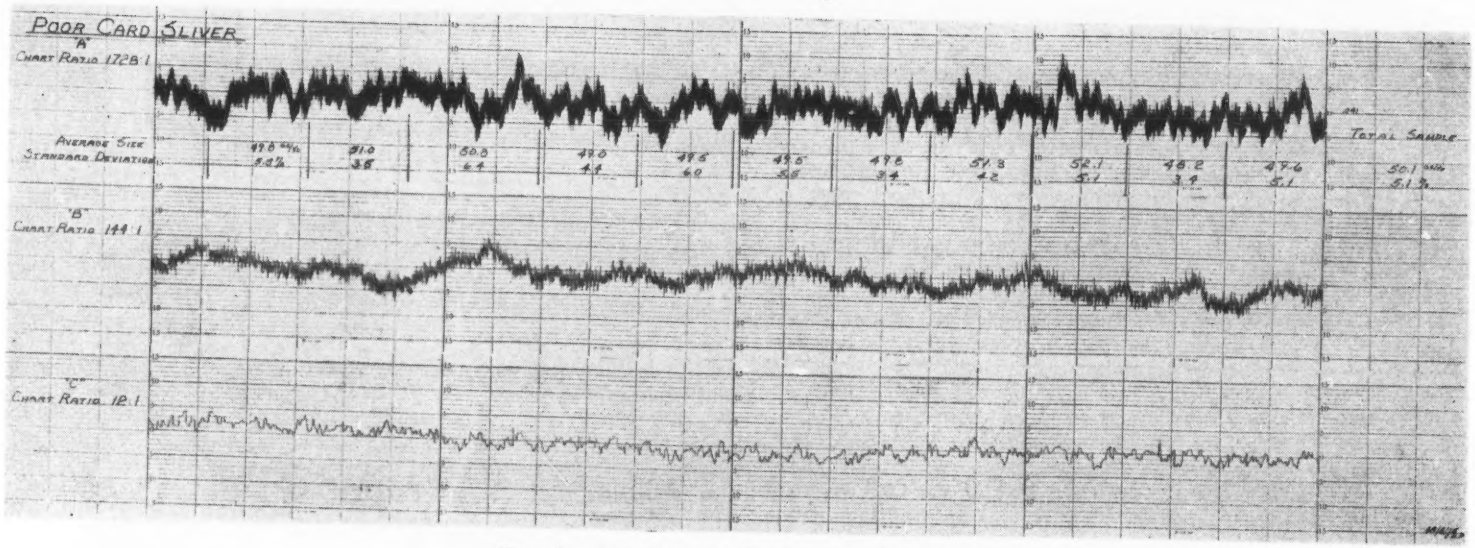

FIG. 4. *Record made from poor card sliver.*

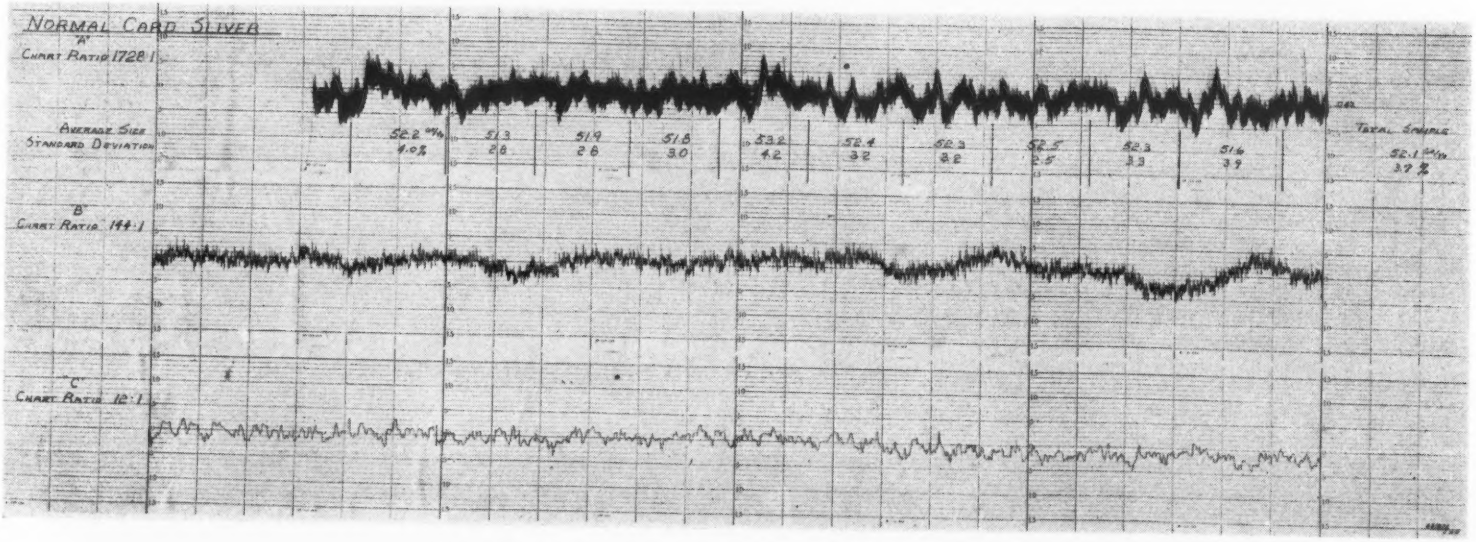

FIG. 5. *Record made from normal card sliver.*

FIG. 5. *Record made from normal card sliver.*

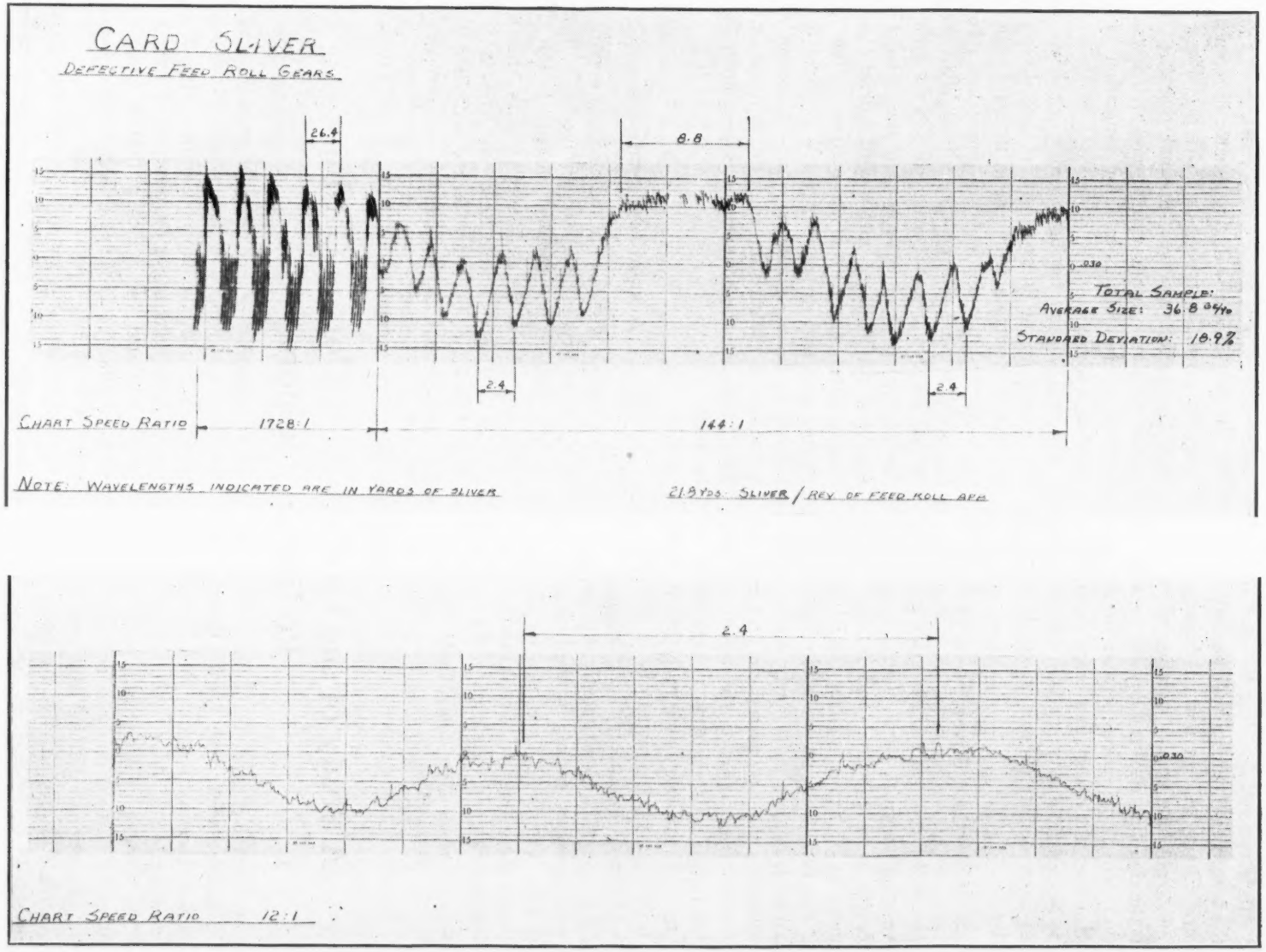

FIG. 6. *Effect of defective feed roll gears on linear density of card sliver.*

pose. Chart "A" is used on drawing sliver to determine the effectiveness of doubling the card sliver to remove the long period density variation common to card sliver. Chart "A" on normal drawing sliver shows some slight long period variation which indicates that the doubling does not entirely remove the long period density variation present in the card sliver. However, the change in average density is so small as to be negligible in comparison with the other changes in linear density present created by drafting irregularity.

Card Sliver

Figures 4 and 5 contrast records made from poor card sliver and normal card sliver respectively. These records were prepared and marked in the same manner as the drawing sliver records just explained. The condensed record made with a chart speed ratio of 1728:1 is particularly useful on card sliver in studying the long period changes in linear density characteristic of card sliver. Since these long period irregularities existing in card sliver are traceable to irregularities existing in the lap, it is possible by utilizing a card known to be in normal operating condition to evaluate picker performance by means of this record.[3] Consequently, the quality of card sliver is governed mainly by the uniformity of the picker lap. Charts "B" are used for closer examination of these long period irregularities. This record also gives a good indication of the amplitude of the short period variations introduced by the card itself. The records made with a chart speed ratio of 12:1 do not show any distinguishable difference between the normal and poor card slivers. These records are useful, however, in analyzing the short period variations due to carding and web formation but are entirely inadequate for evaluation of the sliver as a whole.

Figure 6 is an interesting record which shows what may happen to the linear density of card sliver when mechanical defects are present in the card. In this particular instance the feed roll pinion was mismating with the plate gear on the feed roll shaft during part of its revolution. During part of the cycle the feed of the lap was interrupted and the cylinder was supplying cotton to the output with a drastic reduction in sliver size. From an analysis of the wave lengths indicated in terms of yards of sliver it was possible to definitely analyze what was taking place in the feed to the card and from this information and upon inspection the defective parts were immediately located.

[3] "The Evening Action of the Cotton Card," TEXTILE RESEARCH 14, 20–4 (Jan. 1944).

Acknowledgements

The author wishes to acknowledge the assistance of Mr. John Frydryk, Department mechanic, in making the necessary mechanical changes in the sliver tester, and also of the assistance of Miss Alice Kane and Mr. Michael Kilty, Research Assistants, and Miss Alta King, Secretary, in the compiling of the data and records and preparation of the report.

A Study of the Production of Cotton Carding Preliminary Report

THE cotton carding capacity of the country, although in balance with other yarn manufacturing equipment for peacetime requirements, is inadequate for the manufacture of heavy volumes of military fabrics. The greater predominance of the coarser yarns needed in wartime requires increased carding capacity in proportion to spinning equipment. Therefore any increase in productivity of existing carding equipment should be reflected in direct increase in the country's yarn production, as long as the production increase is not accompanied by significant lowering of the quality of the types of yarns used in military products.

The possibility of increasing the production of cotton cards by changes in speeds and adjustments is being studied at the North Carolina State College School of Textiles under the direction of Textile Research Institute, Inc. This project is being sponsored by Office of Production Research and Development of W.P.B.

It is thought that the conclusions reached from data already obtained are of sufficient importance to the spinning mills of this country to warrant the issuing of a preliminary report. This will be available about March 1. A final report will also be published upon completion of the project.

Sizing of Spun Viscose Warp Yarns
I. Effect of Stretch in Slashing

W. E. Shinn and Paul T. Biggers *

North Carolina State College School of Textiles

Research on warp sizing was conducted by the Textile Research Institute over a period of several years, the earlier research on the warp sizing of filament rayon having been reported in TEXTILE RESEARCH *(see references at the end of this paper). That part of the program covering the period from October, 1940, through November, 1942, has not been published previously. This was in accordance with the agreement between the Institute and the sponsors of the project. The papers in this issue and those to follow in early issues of* TEXTILE RESEARCH *deal with warp sizing of staple rayon and include some of the results of this part of the program which have been thought to be of greatest interest. A summary of this project and of the further study recently completed has been prepared and preparations are being made for publication at an early date.*

IT generally has been accepted that stretch in slashing cotton warps should be kept at a minimum in order to preserve the natural elasticity of the fiber and yarn which contributes greatly to high production in weaving. With the coming of filament rayon, however, it was found that it was possible to slash with considerably more stretch with no detrimental results, and it became general practice to stretch the warp an amount equal in many cases to the contraction in weaving. The practice of spinning synthetic fiber on cotton machinery produces a yarn which resembles cotton yarn in many ways, but which actually is composed of fiber possessing properties entirely different from the cotton fiber, and the natural tendency to treat yarn spun from synthetic fiber according to the traditional methods established for cotton yarns has in many cases led to erroneous assumptions.

Object of Tests

The studies in stretch should be regarded as exploratory. The object of the tests was to determine the influence of stretch on the tensile strength and residual elongation of the warp, also on the weaving quality and on fabric dyeing properties. The tests were undertaken in an effort to secure fuller knowledge of the fundamental nature of yarns spun from viscose fiber. They were suggested by reports from several sources which indicate that spun viscose yarns may be stretched considerably with no detrimental results.

Summary

A series of slashing tests were performed in which the tensions were progressively increased to give a range of stretches varying from approximately 1 percent to nearly 15 percent. Other factors such as the size mixture, slasher speed, drying temperature, etc., were kept constant.

It was found that a warp can be made from 30/1 yarn spun from 1½-inch, 1½-denier viscose staple and the yarn subjected to a stretch of nearly 14 percent between the quetch rolls and the first drying cylinder before end breakage occurs at this point. This figure approximates the total dry elongation of the unsized yarn. At 15 percent serious end breakage occurs on the first cylinder, because of the tendency of the warp to contract in drying.

The tensile strength of the sized yarn was in no case less than that of the unsized yarn and increased with stretch up to 12 percent. The lowest average single strand tensile strength of 8.51 ounces per

* Research Consultant and Research Assistant respectively for Textile Research Institute's Warp-Sizing Research Project.

thread was recorded for yarn stretched 1 percent. The highest tensile strength of approximately 10 ounces per thread was recorded for yarns stretched 12 percent.

Residual elongation at the breaking point showed a marked decrease as the stretch was raised. For each increase of 1 percent in stretch there was a reduction of approximately one half of one percent in residual elongation.

In weaving, the highest end breakage per thousand

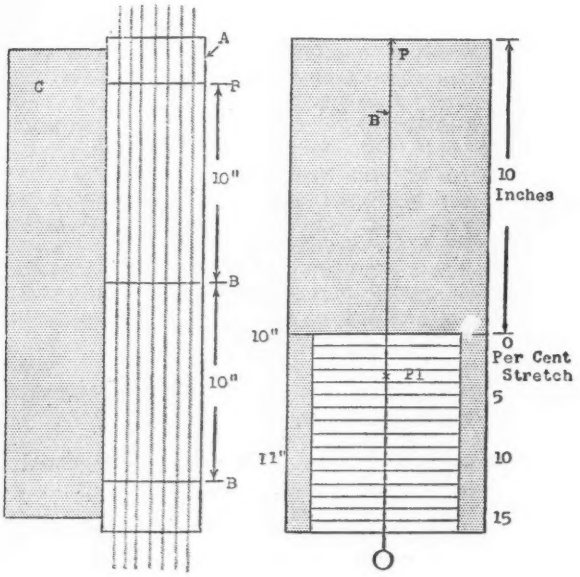

FIG. 1 (*left*). *Diagram of board used for marking warp in stretch determinations.*
FIG. 2 (*right*). *Diagram of board used for measurement of stretch.*

picks was found to coincide with the highest stretch because of cutouts at the heddles. These cutouts are caused by the passage of knots.

It was found that the fabrics representing the highest stretch dyed equally as well as the fabric representing low or normal stretch, and that the finished goods did not exhibit shiners as a result of stretching the warp.

Effect of Stretch on Tensile Strength and Residual Elongation

1. Materials

The yarn in the slasher creel for these tests was 30/1 spun from 1½ inch, 1½ denier viscose staple. The average single strand tensile strength of the yarn was slightly more than 8 ounces per thread.

TABLE I. Summary of single strand tests

Stretch in slashing %	Tensile strength (oz.)	Residual elongation %
1.0	8.52	9.87
2.9	9.02	9.65
5.9	9.36	6.97
9.7	9.86	4.98
10.5	10.04	4.44
12.0	10.10	4.38
14.6	9.89	3.89

Tests were made on a Suter Single Strand Tester of the oil-plunger type. The material was conditioned in standard atmosphere for 3 hours before testing.

The average elongation in an unsized condition was 14.26 percent.

The sizing formula based on 100 gallons of finished size was as follows:

50 lbs. tapioca gum
5 lbs. soluble tallow

The size was brought to a boil, cooked for 10 minutes, and made up to volume and applied with a temperature of approximately 180° F in the size pan.

2. Methods

Operation of the slasher was begun with the tensions reduced to a minimum. For each successive warp the stretch was increased by adding tension between the quetch rolls and the first drying cylinder. The slasher was operated at all times with only enough tension at the front to secure satisfactory separation at the split rods. The minimum stretch recorded was 1 percent. Satisfactory operation of the slasher was experienced with a stretch of 12 percent, but at 14 percent end breakage occurred on the first drying cylinder because of contraction of the yarn in drying. Samples of the warp representing seven different percentages of stretch were taken for testing and warps were made for weaving and dyeing tests.

3. Measurement of Stretch [1]

To determine the actual stretch to which the warp was being subjected it seemed advisable to mark the warp at the rear of the machine at points where the test specimens were to be taken. The warp accord-

[1] The term stretch refers to permanent elongation of the yarn in the process of slashing. A considerable portion of this extension is absorbed by fiber slippage. Therefore it should be remembered that the rayon filaments have not been stretched as much as the yarns.

ingly was marked occasionally at points exactly 10 inches apart. The distance between these points after the yarn had passed through the slasher enabled the stretch to be computed with accuracy. The marking of the warp was accomplished by means of a specially constructed board in which projecting frets were set on 10-inch centers. In practice the board was brought upward beneath the sheet of yarn between the creel and size pan. A sheet of carbon paper placed over the warp and stroked directly over the frets placed indelible marks on each thread at 10-inch intervals. The construction of the device is illustrated in Figure 1.

In taking the readings for stretch, a specially constructed board was set up with a sheet of paper graduated in tenths of an inch located 10 inches below a horizontal line, upon which one mark of the warp thread was made to coincide. A small weight was attached to the lower end of the thread. The position of the second mark could thus be plotted upon the chart below and the percent stretch read directly. This device is illustrated in Figure 2. The thread B is being suspended with the point P coinciding with line L. The second point P_1, originally 10 inches from it, is now 10.35 inches below it, indicating a gain of 0.35 inch, or 3.5 percent.

Results and Discussion

1. Tensile Strength

The results of these tests are summarized in Table I. By referring to this table it will be seen that there is a steady increase in tensile strength as the stretch is increased from 1 percent to 12 percent. This increase is equivalent to 18.5 percent, an average of 1½ percent increase in tensile strength for each percent of stretch. Beyond 12 percent there is a small decrease in tensile strength.

The effects of stretch on tensile strength were contrary to expectations. A decrease in strength with stretch was anticipated, notwithstanding the fact that the rayon manufacturer has been able through stretch spinning to impart desirable physical properties to certain kinds of continuous filament rayons. The improvements in tensile properties witnessed in these experiments are regarded as clearly within the sphere of the yarn structure and doubtless come about as a result of closer and more perfect alignment of the staple fiber through stretching the thread while it is saturated with the size in a plastic condition. It should further be observed that stretching a thread made of discontinuous filaments does not necessarily mean that each individual fiber is stretched to an equal extent since in the spun rayon thread there is opportunity for fiber slippage. The effect of stretch in slashing on tensile strength is plotted in Figure 3.

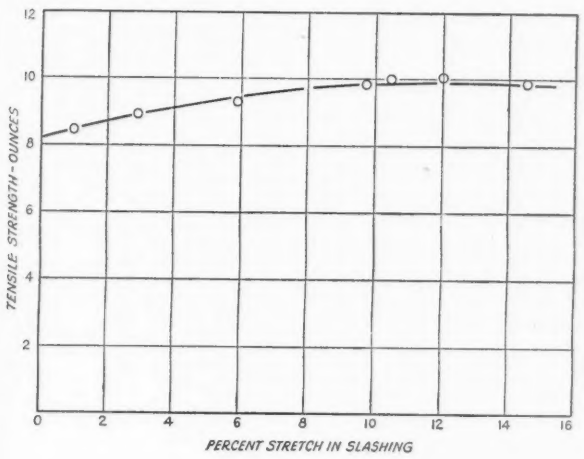

FIG. 3. *Effect of stretch on tensile strength.*

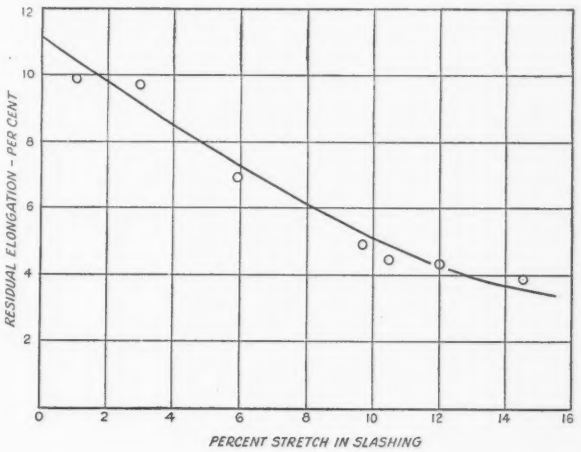

FIG. 4. *Effect of stretch on residual elongation.*

2. Residual Elongation

Elongation is the total pulling out necessary to break a fiber, yarn, or fabric. Residual elongation is the portion which remains after processing. The effect of stretch on this important property is shown

also in Table I. A steady reduction is experienced with each increase in stretch at the slasher. A drop of 6 percent is recorded as the stretch is raised from 1 percent to 14.6 percent. It is an interesting observation that for each 1 percent increase in stretch at the slasher, the warp shows an average loss of only one half of one percent in residual elongation. The effect of stretch in slashing on residual elongation is plotted in Figure 4.

Residual elongation is one of the important properties in warp yarns. Warps low in elongation are brittle and end breakage may be high in spite of high tensile strength. The amount of stretch to which a warp may be subjected in slashing depends to a great extent on the initial elongation or that possessed by the yarn in the creel. When this is low, stretch control is of the greatest importance if good weaving is to result. However, if a spun rayon warp yarn possessing an initial elongation of 14 percent can be slashed with 6 percent stretch and possess a residual elongation of 7 percent in the finished warp, its residual elongation is still equal to that expected of cotton warps of the same count.

Effect of Stretch on Weaving Quality and on Fabric Dyeing Properties

In weaving, the end breakage per 1,000 picks was highest with the highest stretch because of cutouts at the heddles which occur because of the passage of knots. Interference with the opening of the shed between the drop wires and heddles by a single broken warp thread frequently caused a group of adjacent ends to be cut out at the heddles, indicating the need for higher residual elongation in the warp to absorb strains of this character. All of the warps were made from the same lot of yarn and when placed on the loom contained very few knots. The knots referred to in this test were tied by the weaver following end breakage. Adjacent ends frequently were clipped out by becoming caught on the knot in weaving. This type of end breakage was found to occur most often where the warp had been subjected to high stretch.

Weaving Tests

To study the influence of stretch in slashing on the weaving quality of spun viscose warps and the quality of goods produced, three warps were made representing the extremes in stretch and one representing approximately the mean of the two extremes. The first warp was slashed with a stretch of 1.75 percent which would not be classed as excessive in cotton warp preparation. The second warp was stretched 6.35 percent (slightly higher than for filament viscose warps), and the third was stretched 12.25 percent. This represents the maximum stretch to which the warp could be subjected without encountering serious end breakage on the slasher.

The warps were woven into fabric of the same construction (92 × 44 poplin) under similar conditions and the end breakages recorded in the usual manner. The results of the weaving tests recorded in Table II indicate that the extreme of 12 percent is too high, although there seemed to be slightly less shedding of fiber from this warp and a clearer opening of the shed, especially between the drop wires and heddles.

TABLE II. Effect of stretch in slashing on residual elongation and loom stops

Stretch in slashing %	Residual elongation %	Stops per 1,000 picks
1.75	9.90	0.27
6.35	7.00	0.60
12.25	4.40	2.75

Desizing and Finishing

To determine the effect of stretch on the appearance of the finished goods, samples of the material were desized in a 3 percent solution of Exsize. Contrary to expectations, the cloth woven from the warp representing 12 percent stretch was equal in appearance to the cloth made from the warp with 1.75 percent stretch. This would indicate that so far as the appearance of the goods is concerned, stretch control in the slashing of spun viscose yarns is less important than for filament viscose yarns since a stretch of 12 percent would be expected to produce shiners in the fabric woven from the latter. No irregularities in the spun rayon fabric woven from the warp stretched 12 percent were traceable to high stretch.

Dyeing

An effort was made to determine the effect of stretch on the dyeing properties of the fabric. Many

samples were dyed using several direct dyes with and without penetrants. Some difficulty was experienced in obtaining level shades but this could not be attributed to high stretch. The appearance of the cloth representing high stretch was equal in every case to that of the fabric representing low stretch.

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II. Abrasion Testing of Sized Warp Yarns

AMONG the properties of sized spun viscose rayon warp yarns which were studied in the Warp-Sizing Research Project of Textile Research Institute, Inc., was the abrasion resistance of these yarns. One of the principal objects of sizing is to enable the warp to withstand friction and abrasion in a loom. The abrasion testing was used to compare the resistance of spun rayon warps sized by various adhesives and, if possible, to determine the relationship of abrasion resistance and weaving efficiency or end breakage.

This report describes the apparatus used and method of testing and gives the results of a number of tests conducted using various sizing formulas. Table I gives the number of cycles representing the abrasion resistance of each lot; also the durability ratio and durability factor in each case. The following conclusions were reached as a result of these tests:

1. Abrasion resistance was improved through application of all sizing agents. The lowest durability factor (1.8) was observed for a high-soluble dextrin, the highest (7.4) for methyl cellulose. The results were not consistent enough to form clear-cut classifications but in the intermediate group were corn and tapioca gums, thin-boiling starches, and a thick-boiling starch.

2. Low-soluble gums were the most satisfactory as the chief adhesive substances in sizing spun viscose warps.

3. The addition of water-soluble synthetics frequently improves weaving quality without loss of abrasion resistance.

4. The addition of oils and fats as softeners to a starch or gum size paste lowered the abrasion resistance below that obtained by use of the starch or gum alone.

5. No consistent correlation was found between abrasion resistance and weaving performance although the highest weaving efficiency was obtained from a warp having the highest rating in abrasion resistance. The addition of softeners frequently lowered abrasion resistance but improved weaving

TABLE I. Summary of abrasion records

Sizing formula	Abrasion resistance (cycles)	Durability ratio	Durability factor
(1) *70 lbs. thick-boiling corn starch (S-23) 10 lbs. glue (S-35) 5 lbs. glycerin (S-58)	60	7.5	4.7
(2) 50 lbs. white dextrin (S-10) 30 lbs. corn gum (S-11) 6 lbs. Seyco R O (21)	36	4.50	2.4
(3) 100 lbs. low-soluble dextrin (S-30) 5 lbs. Seyco R A A (S-19)	26	3.25	1.9
(4) 100 lbs. high-soluble dextrin (S-26) 5 lbs. Seyco R A A (S-19)	38	4.7	1.8
(5) 70 lbs. dextrin (S-10) 5 lbs. Seyco R A A (S-19)	30.4	3.8	2.2
(6) 100 lbs. corn gum (S-11) 5 lbs. Seyco R A A (S-19)	43	5.4	2.2
(7) 100 lbs. low-soluble gum (S-31) 5 lbs. Seyco R A A (S-19)	36	4.5	2.8
(8) 30 lbs. glue (S-37) 25 lbs. tapioca gum (S-15) 5 lbs. Seyco R A A (S-19) 5 lbs. glycerin (S-58)	43	5.4	2.8
(9) 80 lbs. thin-boiling corn starch (S-27) 30 lbs. gelatin (S-34) 5 lbs. Seyco R O (S-21)	43	5.4	2.5
(10) 60 lbs. (A H C) complete size (S-42) (contents not known)	42	5.25	4.3
(11) 50 lbs. dextrin (S-10) 30 lbs. corn gum (S-11) 2 lbs. Seyco R O (S-21)	32	4.0	2.2
(12) 75 lbs. tapioca gum (S-15) 5 lbs. Cetosol (S-49) 3 lbs. Seyco R A A (S-19)	48	6.0	3.9
(13) 50 lbs. corn gum (S-28) 2½ lbs. Seyco R A A (S-19)	40	5.0	4.0
(14) 65 lbs. thin-boiling starch (S-52) 3 lbs. tallow (S-20)	38	4.75	3.6
(15) 100 lbs. white dextrin (S-30) 3 lbs. tallow (S-20)	30	3.75	2.6
(16) 50 lbs. tapioca gum S-15 5 lbs. tallow (S-20)	38	4.75	4.5
(17) 50 lbs. tapioca gum S-15 5 lbs. tallow (S-20)	38	4.75	4.1
(18) 50 lbs. tapioca gum (S-15) 5 lbs. tallow (S-20)	38	4.75	4.9
(19) 50 lbs. thin-boiling corn starch (S-29)	52	6.5	6.1
(20) 50 lbs. thin-boiling corn starch (S-29) 2½ lbs. sulfonated oil, plus mineral oil emulsion	26	3.25	2.9
(21) 65 lbs. tapioca gum (S-15) (no assistants)	48	6.0	5.3
(22) 65 lbs. tapioca gum (S-15) 5.2 lbs. abietic acid ester (S-12)	44.4	5.5	4.7
(23) 65 lbs. tapioca gum (S-15) 16¼ lbs. abietic acid ester (S-12)	25	3.1	2.4
(24) 15 lbs. methyl cellulose (S-55) (100 C P S)	50	6.2	7.4
(25) 50 lbs. corn gum (S-28) 5 lbs. methyl cellulose (S-55)	40	5.0	5.5
(26) 50 lbs. corn gum (S-28) (no assistants)	28	3.5	3.5
(27) 300 lbs. starch ether (S-53) solution (25% solids) 3 lbs. glycerin (S-58)	42	5.2	3.8
(28) 50 gal. sodium polyacrylate (S-56) (15% solution) 50 gal. water	41	5.1	5.5
(29) 44 lbs. thin-boiling corn starch (S-29) 6 lbs. sodium polyacrylate (S-56)	49	6.1	6.0
(30) Unsized yarn	8	1.0	...

* Based on 100 gallons of size.

efficiency. However, it is known that there is a minimum abrasion resistance which must be maintained for a given construction. This value is the average abrasion caused by weaving plus a reasonable margin of safety. Above this margin abrasion resistance is of no value and may be detrimental, especially if it is attained at the expense of other properties such as flexibility or ultimate elongation.

Equipment Used

The machine used for these tests was a modified fabric abrasion tester in which a drum covered with

300 A silicon carbide paper was reciprocated back and forth on 20 single ends of the yarn until breakage occurred. The machine was operated at a speed of 86 cycles per minute. The speed of the abrasion drum was thus roughly one-half that of the reed in an automatic loom. The tension applied to each thread under test was 1 ounce or approximately one-eighth the average tensile strength of the yarn.

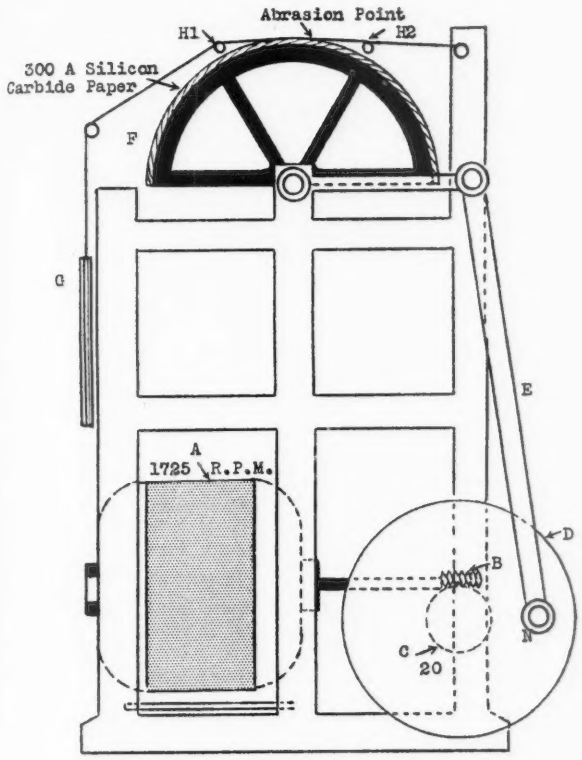

FIG. 1. *Diagram of abrasion tester adopted for abrasion testing of sized yarns.*

This test in reality combines abrasion testing and tensile testing. The readings recorded therefore represent the number of cycles required to reduce the tensile strength of the yarn 87½ percent. It is believed that the use of this weight simulates somewhat the stresses which occur in the loom, especially those which occur when the shed is fully open and when the reed beats up the filling.

The instrument used in these tests is illustrated at Figure 1. A small motor (A), through a worm (B), and worm gear (C), rotates the driving disc (D) at a speed of 86 r.p.m. A pitman (E), attached to an eccentric stud (N), reciprocates the abrasion drum (F). In contact with the surface of the drum is the test specimen (H), which is held under tension by the weight (G). The arc of contact with the abrasive is determined by two guides (H1) and (H2).

Interpretation of Results

The average number of cycles representing the abrasion resistance of each lot of sized yarn was based on 100 ends. In many cases several times this number were tested. From the average abrasion resistance a durability ratio based on unsized yarn was computed as follows:

$$\frac{\text{Abrasion Resistance Sized Yarn}}{\text{Abrasion Resistance Unsized Yarn}} = \text{Durability Ratio}$$

To correct for differences in the amount of size applied to the warp a durability factor was derived as follows:

$$\frac{\text{Abrasion Resistance Sized Yarn}}{\text{Percent Size on the Yarn}} = \text{Durability Factor}$$

Spring Meeting of Committee D-13

The spring meeting of Committee D–13 of the American Society for Testing Materials is planned for March 7 to 9, 1945, to be held as usual at the Park Central Hotel, New York, N. Y., provided permission is granted by ODT.

ABSTRACTS

SERVICES AVAILABLE

Reprints of the original articles abstracted in TEXTILE RESEARCH *are often available from the publishers. Otherwise, it may be possible to secure copies of the periodicals. A list of periodicals, the abbreviations used in references to articles, and the addresses of publishers of English-language publications appears on the following pages. Orders should be sent direct to the publishers.*

Photostat negatives of articles abstracted will be furnished to members of the Institute at a cost of 15 cents per page for pages not exceeding 7 inches in width and 25 cents per page for larger sizes up to 11½ x 14 inches. Postage will be added.

Microfilm copies and paper enlargements of microfilm may be obtained from: Microfilms Inc., 313 N. First St., Ann Arbor, Mich.; New York Public Library, New York, N. Y.; Yale University Library, New Haven, Conn.; Harvard University Library, Cambridge, Mass.; and Library of Congress, Washington, D. C. Translations also may be obtained from the above sources.

It is planned to expand the abstract section and to include abstracts of new patents. The present classification by subjects also will be expanded to facilitate reference.

Subscriptions to reprints of the abstract section for the complete Volume 15, 1945, are still available to members of the Institute for a limited time. These will be printed on one side of the page for clipping and filing in a card index system. The charge for this service is $2.50.

List of Periodicals

American

Name and Address of Journal	*Customary Abbreviation*
American Dyestuff Reporter 1 Madison Ave., New York 10, N. H.	Am. Dyestuff Reptr.
American Society for Testing Materials, Bulletin 260 South Broad St., Philadelphia, Pa.	ASTM Bull.
American Wool and Cotton Reporter 530 Atlantic Ave., Boston 10, Mass.	Am. Wool and Cotton Reptr.
Bulletin of the Institute of Paper Chemistry Appleton, Wisconsin	Bull. Inst. Paper Chem.
Chemical Abstracts Ohio State University, Columbus 10, Ohio	Chem. Abstr.
Chemical and Engineering News 1155 16th St., N.W., Washington 6, D. C.	Chem. and Eng. News
Chemical and Metallurgical Engineering 330 West 42nd St., New York 18, N. Y.	Chem. and Met. Eng.
Chemical Industries 522 Fifth Ave., New York 18, N. Y.	Chem. Ind.
Cotton 1020 Grant Building, Atlanta 3, Ga.	Cotton
Electronic Industries 480 Lexington Ave., New York 17, N. Y.	Electronic Ind.
Industrial and Engineering Chemistry 1155 16th St., N.W., Washington 6, D. C.	Ind. Eng. Chem.
Industrial and Engineering Chemistry, Analytical Edition	Ind. Eng. Chem., Anal. Ed.
Interchemical Review 432 West 45th St., New York 19, N. Y.	Interchem. Rev.
Journal of the American Chemical Society 120 Oxford St., Cambridge, Mass.	J. Am. Chem. Soc.

Name and Address of Journal	*Customary Abbreviation*
Journal of the American Leather Chemists Assoc. 143 West 20th St., New York 11, N. Y.	J. Am. Leather Chem. Assoc.
Journal of Applied Physics 57 East 55th St., New York 22, N. Y.	J. Applied Phys.
Journal of Chemical Physics 57 East 55th St., New York 22, N. Y.	J. Chem. Phys.
Journal of the Franklin Institute Benjamin Franklin Parkway at 20th St., Philadelphia, Pa.	J. Frank. Inst.
Journal of the Optical Society of America American Inst. of Physics, 57 East 55th St., New York 22, N. Y.	J. Opt. Soc. Am.
Journal of Organic Chemistry Mt. Royal and Guilford Aves., Baltimore, Md.	J. Org. Chem.
Journal of Physical Chemistry Mt. Royal and Guilford Aves., Baltimore, Md.	J. Phys. Chem.
Journal of Research National Bureau of Standards Washington 25, D. C.	J. Research Natl. Bur. Standards
Modern Industry 347 Madison Ave., New York 17, N. Y.	Modern Ind.
Modern Plastics 122 East 42nd St., New York 17, N. Y.	Modern Plastics
Paper Trade Journal 15 West 47th St., New York 19, N. Y.	Paper Trade J.
Physical Review, The American Inst. of Physics 57 East 55th St., New York 22, N. Y.	Phys. Rev.
Rayon Textile Monthly 303 Fifth Ave., New York 16, N. Y.	Rayon Text. Mo.
Review of Scientific Instruments 57 East 55th St., New York 22, N. Y.	Rev. Scientific Insts.
Reviews of Modern Physics 57 East 55th St., New York 22, N. Y.	Rev. Modern Phys.
Rubber Chemistry and Technology 1012 Second National Building, Akron 1, Ohio	Rubber Chem. Tech.
Science The Science Press, Lancaster, Pa.	Science
Soap and Sanitary Chemicals 254 West 31st St., New York 1, N. Y.	Soap San. Chem.
Technology Review Mass. Inst. of Technology, Cambridge, Mass.	Tech. Rev.
Textile Bulletin 218 W. Morehead St., Charlotte, N. C.	Textile Bulletin
Textile Colorist and Converter 1 Madison Ave., New York 10, N. Y.	Text. Col. and Converter
Textile World 330 West 42nd St., New York 18, N. Y.	Textile World
British Empire	
British Plastics Dorset House, Stamford St., London S.E. 1, England	Brit. Plastics
Canadian Chemistry and Process Industries 137 Wellington St. W., Toronto 1, Ont.	Can. Chem. and Proc. Ind.

(Continued on next page.)

Name and Address of Journal	*Customary Abbreviation*
Canadian Textile Journal 1434 St. Catherine St., W., Montreal, Canada	Can. Text. J.
Chemistry and Industry 56 Victoria St., London, S.W. 1, England	Chemistry and Industry
Engineer, The 28 Essex St., Strand, W.C. 2, England	The Engineer
Indian Textile Journal Military Square, Fort Bombay, India	Indian Text. J.
Journal of the Chemical Society Burlington House, London W. 1, England	J. Chem. Soc.
Journal of the Society of Chemical Industry 56 Victoria St., London, S.W. 1, England	J. Soc. Chem. Ind.
Journal of the Society of Dyers and Colourists The University, Leeds, England	J. Soc. Dyers and Colourists
Journal of the Textile Institute 16 St. Mary's Parsonage, Manchester, England	J. Text. Inst.
Nature Macmillan & Co., Ltd., St. Martin's St., London, England	Nature
Physics Abstracts Inst. of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C. 2, England	Phys. Abstr.
Proceedings of the Physical Society 1 Lowther Gardens, London, S.W. 7, England	Proc. Phys. Soc.
Proceedings of the Royal Society Cambridge University Press 200 Easton Road, London, N.W. 1, England	Proc. Roy. Soc.
Silk and Rayon St. James House, 44 Brazennose St., Manchester 2, England	Silk and Rayon
Silk Journal and Rayon World Old Colony House, S. King St., Manchester 2, England	Silk J. Ray. World
Textile Journal of Australia 19–47 Jeffcott St., Membourne, Australia	Text. J. Australia
Textile Manufacturer 21 Bedford St., Strand W.C. 2, London, England	Text. Mfr.
Textile Recorder Old Colony House, South King St., Manchester, England	Text. Recorder
Transactions of the Faraday Society 33 Paternoster Row, London, England	Trans. Faraday Soc.

German

Chemisches Zentralblatt	Chem. Zentr.
Deutsche Farber-Zeitung	Deut. Farber-Zeit.
Journal für practische Chemie	J. pract. Chem.
Kolloid-Zeitschrift	Kolloid-Z.
Kunstseide u. Zellwolle	Kunstseide u. Zellwolle
Melliand Textilberichte	Melliand Textilber.
Naturwissenschaften	Naturwissenschaften
Zeitschrift für physikalische Chemie	Zeit. physik. Chem.

ABSTRACTS

ANALYSIS: TESTING LABORATORY METHODS

★

Electron Optics

Historical background of electron optics. C. J. Calbick. *J. Applied Phys.* **15**, 685–90 (Oct. 1944).

A development of the background concerned with electron optics is presented. Early methods for producing narrow beams of electrons are described, and the evolution of the cathode-ray tube is traced. Such physical implements as the oscillograph and the electron microscope are discussed in their development stages. A description is given of a number of electron lens experiments.

Fiber Density

The density of textile fibers. I. J. W. Illingworth. *Textile Recorder* **61**, No. 737, 60–2, 64–5 (1944) (through *Chem. Abstr.*, 1944, **38**, 6102[1]).

A density determination together with the regain value from the saturated vapor is perhaps the most accurate method of determining the swelling characteristics of a fiber when it is immersed in a medium. These swelling characteristics exert a considerable influence on the technique and method of treatment of the fiber in manufacture. The density of a fiber in an inert medium such as benzene is usually very close to the value obtained for the over-all density. Porosity of these fibers is apparently very small and swelling must take place before there is appreciable penetration of the fiber. An anomalous density figure indicates penetration. The apparent density at any regain $= 100 + R/[(100/Da)(R/Ds)]$(1), where R is percentage regain, Da = apparent density of the dry fiber and Ds the density of the swelling medium. This permits calculation of the apparent density at any regain, knowing the apparent density of the dry fiber. The volume swelling which accompanies absorption of a swelling medium by a filter is readily calculated from density data. Percent volume swelling $Sv = 100(Vr - Vo)/Vo$ (2), where Vr is the volume of the fiber at a regain of R, Vo is the volume of the fiber at zero regain. Do and Dr are the true ds of the fiber at zero regain, and a regain of R, respectively, then considering 100 grams of dry fiber, $Vr = (100 + R)/Dr$, $Vo = 100/Do$; volume swelling $= [Do(100 + R)/Dr] - 100$ (3). Equations (1) and (3) can also be applied to nonaqueous media.

Molecular Weight of Cellulose

Measurement of average degree of polymerization. O. A. Battista. *Ind. Eng. Chem. Anal. Ed.* **16**, 351 (June 15, 1944).

Viscosity-concentration data are given for five samples of purified cellulose representing the degree of polymerization range from 300 to 3000. On plotting the data on semilogarithmic paper, linear relationships were found to exist, in each case, between (1) the viscosity function $\frac{nsp}{c}$ and concentration, and (2) the relative viscosity function measured at 0.5% concentration and the degrees of polymerization corresponding to values calculated from viscosity-concentration data extrapolated to infinite dilution. The data have been used to derive a mathematical expression by means of which the value of the viscosity function at the standard concentration of 0.5% may be converted to degree of polymerization data equivalent to values obtained by extrapolation of viscosity-concentration data to infinite dilution.

Photoelectric Photometer

A general purpose photoelectric photometer and its use in textile laboratories. N. H. Chamberlain. *J. Text. Inst.* **35**, T61–76 (June, 1944).

A general-purpose photoelectric photometer suitable for routine use in textile laboratories is described, and some constructional details given. Typical results are quoted, which have been obtained in using the photometer as nephelometer, absorption colorimeter, fiber diameter micrometer, glossmeter, and photographic density meter.

Permeability Tests

Application of a thermal conductivity method to the determination of moisture vapor transmission of packaging materials. L. Boor and J. K. Dixon. *Paper Trade J.* **119**, 26–34 (Nov. 2, 1944).

The application of the Permeameter which was developed to measure permeability of balloon fabrics to hydrogen to the measurement of water vapor transmission is described herein. Certain modifications were required to make this adaptation, all of which are given in detail and their effects are noted. A systematic comparison was made of the various methods used for measuring water vapor permeability; the methods included are the Payne cup method, pie plate method (similar to the General Foods moisture vapor transmission test), the TAPPI standard method, and the Institute of Paper Chemistry method. The data given indicate that the Permeameter can be used to measure the permeability of the different materials and possesses certain advantages over the other procedures. Also to be noted is the fact that the time required for testing is of such short duration that the instrument can be readily adapted for control purposes.

Redox Potentials

Oxidation-reduction potentials: Their significance and applications. H. I. Stonehill. *J. Soc. Dyers and Colourists* **60**, 176–83 (July, 1944).

The oxidation-reduction potential of a solution is a quantitative indication of the state in which the opposing oxidizing and reducing powers of a substance or system come to equilibrium. Since the reaction $Fe^{++} \rightarrow Fe^{+++} + e$ can occur in pyridine

solution, in the absence of oxygen, the suggested electron-transfer mechanism of oxidation-reduction is probably correct, and is adopted as the best theoretical approach to the subject. To obtain a stable reversible redox potential both reduced and oxidized forms of a system must be present, and the system must be both chemically and thermodynamically reversible. The determination of standard redox potentials is discussed; it is pointed out that while potentials measured in irreversible redox systems can have no thermodynamic significance, many technically important processes are of this nature and potential measurements in them do give a comparative indication of the relative ease of oxidation or reduction; several methods of making such measurements are considered. Potentiometric redox titrations have significant application in investigation of extent of semiquimone formation; in this way many important vat dyes have been studied and data obtained related to ease of vatting and fastness of the dye, as well as information concerning the relation of dye properties to molecular structure. The theory and use of internal redox indicators, and the measurement and significance of rH values of redox solutions is discussed. The possibilities of redox potentials as a powerful chemical tool have not yet been fully realized.

Spectrophotometry

Spectrophotometry in evaluating colorants. W. G. Granville. *Interchem. Rev.* **3**, 71–8 (Autumn, 1944).

The fundamentals of light and its reflectance and absorption are reviewed and the application of spectrophotometry to the evaluation of selective absorption, particularly of pigmented films, is discussed. The G. E. recording photoelectric spectrophotometer (which consists of a double-prism monochromator equipped with automatic slit adjustment for a 10 millimicron wavelength band, a photoelectric photometer of the polarization type, and a recording mechanism) is used for permanently recording the characteristics of pigmented films, for evaluation of pigment tinting efficiency, and for identifying pigment colorants. The spectral reflectance curves of 21 commercially important pigment colorants are illustrated. Spectrophotometry in its industrial applications appears destined to increasingly supplement, though not to supplant, the human eye.

Yarn Shift Tester

New yarn shift tester. C. A. Baker. *Rayon Text. Mo.* **25**, 63–4 (Oct. 1944).

The use of man-made filament yarns has added to the problem of the shifting of yarns in a fabric. A new tester designed to accurately determine the tendency of yarns in a fabric to shift and cause openings has been developed. The new tester measures the amount of pressure necessary to create an opening in the fabric. Illustrations of the apparatus are shown.

CHEMICAL AND PHYSICAL RESEARCH

★

Alpha-Cellulose

Some aspects of alpha-cellulose from wood pulp. N. W. Coster and Rex Vincent. *Paper Trade J.* **119**, 117–29 (Sept. 21, 1944).

The determination and importance of the alpha-cellulose content of wood pulp are discussed. It is the authors' opinion that the existing tests are not wholly satisfactory in that they do not indicate all the properties which are necessary in the evalution of pulp for specified uses. Alpha-cellulose has been defined as that fraction of the pulp which is insoluble in 17.5% NaOH at 20° C having a D.P. of 200 or more. The effects on the yield of a product meeting such requirements by the pulping and bleaching processes, and by operating densities and temperatures are given.

Alkyd Resin Extraction

Extraction of alkyd resins. Howard J. Wright and Robert N. Du Puis. *Ind. Eng. Chem.* **36**, 1004–08 (Nov. 1944).

The problem of extracting alkyd resins, with lower monohydric alcohols was investigated. Factors such as method of preparation, degree of polymerization, excess hydroxyl and carboxyl groups, oil length, fatty acid modifiers, and substitution of other polyhydric alcohols for glycerol in the resins were studied to find the amounts of extractable material present when such conditions were varied. Films were prepared from fractions of the resins extracted, by both baking and air-drying, and were stored under controlled humidity conditions. The alcohol-insoluble fractions of alkyd resins dried more rapidly and to harder films than the original alkyds from which the fractions were obtained. None of the films showed any signs of brittleness. Films from the alcohol-soluble fractions remained soft and tacky. Analyses of fractions showed that alkyds are probably mixtures of resins of various oil lengths and that the shorter oil length portions comprise the unextractable material. Methods of utilizing the extractable portions of alkyd resins were found. The improvement in the properties of extracted alkyds may in the future promote commercial utilization of such processes.

Sorption of Vapors by Cellulose

The study of cellulose fibers. V. Sorption of organic vapors by cellulose fibers. K. Lauer. Kolloid-Z **107**, 86–8 (May, 1944). (In German) (through *Bull. Inst. Paper Chem.* **15**, 85–6, Nov. 1944).

The results which in general confirm those earlier obtained by Kanamaru and Chao (cf. B.I.P.C. 9: 10) show that the adsorption isotherms of purified cotton for all organic liquids investigated deviate from the S-shape isotherm characteristic for water. Nevertheless, the adsorption isotherms for the lower (polar) alcohols (methanol and ethanol) reflect, as do those for water, the overlapping of adsorption and swelling phenomena, though in a different order. In contrast, propanol, isopropanol, and butanol, as well as benzene, toluene, paraffin hydrocarbons, carbon tetrachloride, and chloroform produce pure adsorption

isotherms without involving swelling phenomena. Acetic acid produces swelling only, whereas acetone shows indifferent behavior at low, and adsorption at higher vapor pressures. Similar results are obtained with viscose rayon. Swelling-by-weight and swelling-by-volume data are compared and confirm the results shown by the isotherms. Heat of sorption is found to be positive in all cases, but the difference which native cellulose and cellulose hydrate fibers show in water disappears in most organic liquids.

Colorimetry

Quantitative data and methods for colorimetry. O.S.A. Committee on Colorimetry. *J. Opt. Soc. Am.*, **34**, 633–88 (1943).

This is Chapter VII of the forthcoming Colorimetry Report, of which several sections have already been published. This section contains 36 tables and 27 figures that provide the basic data for colorimetry—spectral distributions of daylight, sunlight, practical sources of artificial daylight, standard luminosity data, tristimulus values of the spectrum, computational data for both the weighted and the selected ordinate method for I.C.I. and Planckian radiators as well as all other illuminants listed above. In this chapter are assembled the most necessary data for colorimetry—material heretofore available only in scattered sources. It will serve, with the chapters already published, as a handbook for colorimetry, until such time as the book itself can be published.

Enzymes

A critical examination of the Loehlein-Volhard method for the determination of the proteolytic activity of enzymes. J. G. Niedercorn, F. D. Thayer, and D. E. Evans. *J. Am. Leather Chem. Assoc.* **39**, 342 (Sept. 1944).

The original Loehlein-Volhard method may be modified by using as a substrate any protein soluble in water and capable of being precipitated from moderately concentrated acid solution (provided the precipitating agent does not interfere with the titration of the filtrate) or any insoluble, finely-divided protein capable of combining with acid. This conclusion resulted from work with casein, keratose, hide powder, collagen, and elastin as substrates. It was also shown that borate buffers could be used in the digestions, minimizing changes in pH, and giving a very sharp end-point.

Ultraviolet Light

Effect of ultraviolet light on cellulose acetate and nitrate. T. S. Lawton, Jr., and H. K. Nason. *Ind. Eng. Chem.* **36**, 1128–30 (Dec. 1944).

The effect of ultraviolet light on the viscosity of cellulose acetate and cellulose nitrate has been studied in atmospheres of air, nitrogen, and oxygen. In air and oxygen the degradation of these cellulose esters is accelerated. The effect of a nitrogen atmosphere is to retard degradation. In all atmospheres the drop in viscosity for cellulose acetate was gradual; for cellulose nitrate the viscosity dropped more rapidly during the initial part of exposure and then leveled off.

Structure of Cellulose Fibers

The study of cellulose fibers. VII. The physical structure of fibers. K. Lauer. Kolloid-Z. **107**, 93–103 (May, 1944). (In German) (through *Bull. Inst. Paper Chem.* **15**, 90–1, Nov. 1944).

The article, which is mostly speculative, deals particularly with the dry and wet strength of native cellulose and cellulose hydrate fibers (including mercerized cotton fibers) measured in water and organic liquids. An explanation for the different behavior of the various types of fibers toward different liquids of immersion is attempted on the basis of two assumptions. (1) The native cellulose fiber is conceived as being built up of spiral ribbons composed of lamellas, representing the crystalline portions of the fiber, with the amorphous portions in between the spiral ribbons, the lamellas being composed of fibrils which run parallel to the fiber axis. In contrast, cellulose hydrate fibers are pictured as lacking the spiral-ribbon arrangement, the crystalline and amorphous portions being arranged at random. (2) Hermans' β-glucopyranose model (cf. B.I.P.C. 13: 428), in which the hydroxyl groups are located on one side of a plane, and believed to be projected parallel to the fiber axis, through the anhydroglucose ring, whereas the hydrogen atoms are located on the other side of the plane. In their behavior toward water and organic liquids, distinction is thus made between hydrophilic planes (hydroxyl groups) and hydrophobic and lyophilic planes (C-H groups). Since the main forces which are effective as lattice energy ("forces of orientation") are produced by oppositely located hydroxyl groups, it is probable that the ring planes with the C-H groups lie on the outer surfaces of the spiral ribbons ("forces of dispersion"). It is suggested that, on the immersion of the fiber in water, the water molecules combine only with those hydroxyl groups which are located in the amorphous portions of the fiber, whereas organic liquids are adsorbed on the lyophilic planes. The difference in wet-strength retention between native cellulose and cellulose hydrate fibers is explained by the assumption that the surfaces of the crystalline portions of native cellulose fibers are hydrophobic, whereas those of the cellulose hydrate fibers are hydrophilic. Thus the tensile strength and elongation of the cotton fiber are retained or even increased in the water-wet state, but decrease in benzene, pyridine, and glacial acetic acid. In contrast, the tensile strength of cellulose hydrate fibers increases in glacial acetic acid but the elongation decreases. Mercerized cellulose (prepared with or without tension) shows a behavior toward water and organic liquids which is more similar to that of cotton than to that of the cellulose hydrate fibers. Freezing of wet cellulose fibers at about $-150°$ C causes no loss in tensile strength for cotton; however, staple fiber loses between 10 and 40%. Both fibers show an increase in elongation. The swelling ability of the frozen cotton fiber increases, whereas that of the staple

fiber decreases. These results are interpreted to show that, in the case of the cotton fiber, freezing results only in a loosening-up of the physical structure, whereas in the case of the staple fiber, primary valences are also ruptured. Strength, elongation, and swelling of mercerized cotton remain practically unchanged after freezing, whereas formaldehyde-treated staple fiber shows similar losses as ordinary staple fiber, with the exception of the swelling ability, which increases. Freezing of the various types of fibers in air-dry condition produces similar results, but to a considerably smaller extent. 23 references.

Fibrous Proteins and Acids

The combination of fibrous proteins with acids. G. A. Gilbert and E. K. Rideal. *Proc. Roy. Soc.* **182**, 335–46 (June, 1944).

An approximate titration equation is developed for the reaction between fibrous proteins and acids, in which account is taken of the valency and intrinsic affinities of the acid anions, and of the limited number of adsorption sites available for anions. The transition from soluble to fibrous proteins is traced in order to demonstrate that the main difference between the titration curves of the two types of protein arises from the difference in potential developed during the adsorption of protons.

Structure of Collagen Fibers

X-Ray and electron microscope studies of the structure of collagen fibers. Francis O. Schmitt. *J. Am. Leather Chem. Assoc.* **39**, 430 (Nov. 1944).

X-ray diffraction patterns of fibers from tendons show short-spacing equatorial diffractions at about 11 Å, corresponding to the lateral distance between polypeptide chains, and meridional diffractions at 2.86 Å, perhaps the average length of amino-acid residues along the chains. Long-spacing diffractions are orders of a fundamental fiber-axis period of about 640 Å. Electron micrographs showed collagen fibrils to have alternate transverse dark and light bands with an average spacing of 644 Å. The dark bands are thought to be caused by denser packing of the protein. When the fiber is stretched, the light bands lengthen at the expense of the dark ones. The long-spacing may range from 550 Å (heat-shortened fibers) to 675 Å (moist fibers), but the meridional spacing is practically invariable, and is thus not a definite high order of the fundamental period of 640 Å, as suggested by Astbury. Tanning agents reduce the fiber-axis period. (A report of subsequent oral discussion by Max Bergmann, R. S. Bear, and others, gives a general survey of the problems involved in determining the structure of collagen.)

X-Ray Studies of Collagen

X-ray diffraction studies on protein fibers. I. The large fiber-axis period of collagen. Richard S. Bear. *J. Am. Chem. Soc.* **66**, 1297–1305 (Aug. 1944).

Small angle X-ray diffraction patterns of collagen from a number of vertebrate animal sources show a large fiber axis period of 640 Å. Wetting lengthens this period up to 680 Å and processes similar to tanning reduce it to about 615 Å. Relative diffraction order intensities differ between moistened and dried samples. For dry samples, the orders extend out to angles corresponding to about the thirtieth order indicating a considerable regularity in the structure. No apparent relation has been found between variations in the large period and the diffraction observed at wide angles. This is interpreted to mean that the wide angle (short) spacings are related to but a portion of the entire matter constituting the macroperiod.

Furfural Resins

The polymerization and structure of furfural resins. William S. Penn. *British Plastics* **16**, 286–92 (July, 1944).

The polymerization of furfural has been poorly understood and as a consequence furfural resins have frequently been condemned. Actually, a variety of resins may be made from furfural, both thermoplastic and thermosetting. This is due to the fact that in addition to condensing with such materials as phenol, furfural can condense or polymerize with itself in five different manners. In view of this, it is easily understood why polymerization of the furfural resins was formerly difficult to control and caused them to be unpopular. By means of hydrogenation and other devices, this problem has been largely solved. Due to the low price of furfural, these resins appear to have a promising future.

BLEACHING: DYEING: FINISHING

★

Finishing Rayon Hose

The finishing of women's rayon hose. Anon. *Silk & Rayon* **18**, 551–2 (May, 1944).

The two methods used to finish women's hose are described. The first is the so-called stationary "steam press" method. In the second process, the hose traverse a closed circuit in which they pass through different treatments which together constitute the finishing process. The methods differ, particularly as regards their effect on the stitch structure. This results in a difference of appearance in the hose finished by the two methods. It is difficult to explain the difference; but on the whole the appearance given by the second method is preferred.

Clay for Sizing

Clay as substitute for flour in sizing textiles. D. Shil'pin. *Tekstil. Prom.* **4**, 5–6 (1944) (through *Chem. Abstr.* 1944, **38**, 6571[7]).

Clay has been satisfactorily substituted for a part of the flour in textile size. A clay suspension, which may be stabilized by sodium silicate, in hot H_2O and a flour paste are prepared separately and then mixed together.

Inorganic Salts in Dyeing

Dyeing textiles with inorganic salts. F. I. Sadov. *Tekstil. Prom.* **4**, 11–13 (1944) (through *Chem. Abstr.* 1944, **38**, 6565[4]).

Cotton fabrics can be dyed khaki in

hues from brown through olive to light brown, equally well with $CuSO_4$ or $FeSO_4$ alone as with a combination of tannins, S dyes or C black and the metal salts. The use of metal salts is complicated and the colors obtained are insufficiently resistant to acids and (in some instances) to rubbing; hence the metal salts should be used only when substantive or S dyes cannot be used. Details of procedure are described.

FIBERS: YARNS: FABRICS: MECHANICAL PROCESSES

★

New polymeric compounds developed for fiber and film manufacture. *Anon. Silk and Rayon* **18**, 815, 817, 899 (Aug. 1944).

A discussion of the preparation of the new fiber forming resins disclosed in B.P. 560,784, 560,785 and 560,786. The preparation of all these resins follows more or less the method used to prepare biuret from urea, a diamine is heated to about 250° C in an autoclave in the absence of oxygen. Due to ring formation, urea itself cannot be used as a raw material. Among the raw materials discussed are hexamethylene di-urea, hexamethylene, di-thiourea, hexamethylene diamine, and the like. These diamines react in a similar manner with amino acids to yield more complex resins. Fibers made from these resins are not described other than to say they have some properties similar to those of nylon, silk and wool.

New Nylons

Progress in nylon manufacture points to new, perhaps better, fiber variations. Anon. *Silk & Rayon* **18**, 544, 546, 548 (May, 1944).

New types of nylons can be made by the introduction into the reaction mixture of a glycol in addition to the dicarboxylic acid and diamine. The properties of resulting resin vary greatly depending upon the percentage of glycol used. Data is given illustrating the effect of percent glycol on such properties as hardness, melting point, and elastic recovery. The polymers produced by this process contain both the ester and the amide linkages and, hence, have the properties of both polyamides and polyesters.

Fibers

Modern knowledge of textile fibres. Anon. *Silk J. Ray. World.* **20**, 34–8 (Apr. 1944).

A description of the natural fibers: silk, cotton, flax wool. The natural habitat of each is given. Photomicrographs of Sea-island, Nigerian, and Indian cottons and of ramie & kemp are included.

Silk Production

Some notes on silk production. Eric Hardy. *Silk J. & Ray. World* **20**, 24–5 (Apr. 1944).

A review of the work being done by various countries to produce raw silk now and in the post war years. American industries have established centers in the Bahamas, Puerto Rico, and Venezuela. The Free Belgian government has made much progress in the Belgian Congo producing a high quality silk suitable for surgical use. Same is produced in Yugoslavia, Russia, and may be produced more extensively in the Mediterranean area. Possibilities for exploitation of British wild silk are discussed.

Acetylated Casein Fiber

Acetylated casein fiber. Alfred E. Brown, W. G. Gordon, Edith C. Gall, and R. W. Jackson. *Ind. Eng. Chem.* **36**, 1171–75 (Dec. 1944).

Casein fiber as ordinarily hardened with formaldehyde is inferior to wool as a textile fiber because of its lower tensile strength, especially when wet, and because of its poor resistance to boiling, particularly in mildly alkaline solutions. Claims have been made that acetylation improves some of the inferior properties of protein fiber. No quantitative report on this problem has appeared, so an investigation was made with casein fiber prepared in this Laboratory. Acetylation was carried out with acetic anhydride under various conditions, including the presence of catalysts. Acetyl contents from 1.0 to 9.0% were obtained by varying the time and temperature. Correlations between acetyl content and various properties are reported. Acetyl contents of about 6% could be introduced with no loss of wet or dry tensile strength. Fibers of such acetyl content are superior to the untreated control fiber in regard to resistance to boiling solutions simulating dye-bath conditions. They also have the desirable property of a greatly decreased affinity for acid dyes—i.e., dyes with colored anions —and thus more closely approximate wool in dye uptake.

Measuring Irregularity of Carded Web

A method of measuring the irregularity of carded web. A. Varga and N. H. Chamberlain. *J. Text. Inst.* **35**, T89–92 (July, 1944).

The photoelectric photometer can readily be utilized to measure the regularity of carded web. A fixed slit is set up in front of the photoelectric cell of the photometer and the web sample, mounted between strips of glass, is traversed behind the slit in a direction perpendicular to the optical axis of the photometer. The output of the cell is measured at intervals as the web traverses the slit. This quantity is inversely proportional to the opacity and hence the density of the web. The curve obtained by plotting density against distance across web gives at a glance the degree and location of all irregularities in the web. The irregularity may be expressed quantitatively as the coefficient of variation. The technique described for obtaining reliable samples involves applying a 4 inch wide strip of "scotch tape" to the web on the doffer cylinder and pressing it against the wires with a photographers' squeegee.

Action of Phenol on Wool

The action of phenol on wool. T. Borr and J. B. Speakman. *J. Text. Inst.* **35**, T77–88 (July, 1944).

Wool fabrics undergo rapid and pronounced shrinkage when they are immersed in concentrated aqueous solutions of phenol or melted phenol.

Shrinkage is complete in 15 minutes and increases in extent with increasing temperature of treatment up to 90° C at least. When the treated fabric is washed in water, it tends to revert to its original area, but part of the shrinkage—about a third—persists after a 24 hour wash in running water. Shrinkage appears to be due mainly to the pronounced lateral swelling of wool fibers in concentrated aqueous solutions of phenol, accompanied by a slight length contraction. In addition, there must be some relative movement of the fibers during phenol treatment, and washing, because part of the shrinkage of a fabric is permanent to washing, whereas fibers swollen and contracted in phenol revert to their original dimensions when the phenol is removed. When a fabric is subjected to repeated treatment with hot phenol and water, alternately, almost the whole of the initial shrinkage in phenol can be made permanent to washing, presumably owing to the relative movement of the fibers. A process of this type might have special advantages in cases where pronounced shrinkage is desired without the development of cover, but the difficulty of recovering phenol from the wash water seems likely to prevent widespread use of the method. The primary shrinkage of the fabric in phenol can, however, be made permanent by steaming at 102° C for 10 minutes. By its heating effect, the steam accentuates the shrinking action of phenol, and the enhanced shrinkage is fixed by the occurrence of setting reactions in the fibers of the contracted fabric. Setting reactions are, however, inhibited by acid, and when a series of phenols of increasing dissociation constant were examined, it was found that the dissociation constant must not exceed 1×10^{-9} at 25° C if the primary shrinkage is to be fixed in steam. For the same reason, fabrics which are likely to retain acid from previous processes, e. g. chlorination, must be neutralized before the application of phenol and steaming. It seems likely that the main application of the process will be in the production of wool crepes by steaming fabrics on which a suitable phenol has been printed.

Enemy Textiles

Quartermaster corps releases data on enemy textiles. Harold E. Reed. *Textile World* **94**, 79–83 (Oct. 1944).

Battle garments used on the various fronts by the Germans and by the Japanese are described and photographs are shown. Analysis of German military clothing taken from captured personnel indicates that Germany was not too well prepared to fight a long battle in Europe under as varying climatic conditions as those with which she found herself confronted. Illustration of this fact that many pieces, notably the camouflaged items used in the Italian campaign, were improvised in the field from shelter tent halves. The Germans have a great many specialized garments and fabrics whereas the U. S. Army has simplified its uniforms to a basic few. Extensive use of rayon has been resorted to in order to conserve the fast-dwindling supply of wool and of cotton. It is apparent that Japan also has a severe wool shortage. The Japanese have shown some originality in the development of uniforms but the originality is in the utilization of available raw materials and not in the production of a fabric or a garment having superior qualities.

MISCELLANEOUS

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Applications of Plastics

Modern plastics—their manufacture and uses. Anon. *Silk and Rayon* **18**, 537 (May, 1944).

The sixth of a series in which is reviewed the application of urea-formaldehyde resins to textiles. The following English patents are reviewed briefly: 291,473; 391,474; 437,642; 445,773 and 555,575.

Fibrous plastics materials. W. E. Parsons. *British Plastics* **16**, 314–16 (July, 1944).

Fibrous plastics are those in which the fibers, usually cellulosic in nature, remain unchanged chemically in the finished molded product. The resins used include the thermosetting plastics of the phenol-formaldehyde, urea formaldehyde, and the melamine-formaldehyde types. The process for incorporating synthetic resin into molded pulp products is described. This is accomplished by mixing of the two in pulp beaters before forming into the desired shape.

Laminates

Melamine laminates. R. H. Malamphy. *Paper Trade J.* **119**, 134–6 (Sept. 28, 1944).

The many uses to which melamine resins are applied and a general summary of the characteristics imparted to the various products are given. The manufacture of laminates requires special characteristics for the necessary components and they must be properly adjusted to meet the requirements of the conversion processes. Melamine resins are well adapted for white and light pastels as well as sheets of other colors. They also find use in translucent sheets. Among its properties are high resistance to abrasion and the action of solvents and heat resistance. In the laminating field they have found use with other fillers such as glass fiber, asbestos, textile fabrics and plywood. The melamine resins are also used in the manufacture of wet strength papers.

Belt Conveyors

A technical analysis of the belt conveyor. Wilbur G. Hudson. *Chem. and Met. Eng.* **51**, 104–8 (July, 1944).

The author describes belts and accessories, driving equipment and drive methods and lists the chief sources of trouble and their correction. He shows also how favorable belt conveying costs may compare with some of the competing methods of mechanical handling.

John Mercer

John Mercer and mercerization, 1844. , Sister Virginia Heines. *J. Chem. Ed.* **21**, 430–3 (Sept. 1944).

An historical review of the mercerization process and containing a biographical sketch of John Mercer. 26 references.

Paper Base Plastics

Phenolic resins for paper base plastics. H. Kline. *Paper Trade J.* 119, 128–30 (Sept. 28, 1944).

The phenols, cresols and xylenols are the primary base materials generally used with aldehydes in the production of resins for paper base plastics. However, the selection of materials is not limited to the above as there are many possible combinations, the selection of which is dependent on the effects desired. To meet specified requirements, modifications may be made by varying the type of phenolic body used, the kind of catalyst, the ratio of formaldehyde to phenol, the method of reaction, etc. The use of phenolic resins in the beater is considered briefly.

Rubber Saturants

The general aspects of GR-S rubber saturants. Ralph T. Nazzaro. *Paper Trade J.* **119**, 131–4 (Sept. 28, 1944).

The relative value of synthetic rubbers in general for the treatment of paper is discussed. The composition, reactions, and properties of rubber latex, GR-S latex, and polyvinyl acetate resin are given. Performance and test data indicate that GR-S latex may be used with and substituted for rubber with satisfactory results in most respects although it does not have the particular combination of physical and chemical properties of natural rubber.

Organization of a Research Association

The functions and organization of a research association. Robert Pickard. *World's Paper Trade Rev.* **121**, 1483–84, 1519–21 (June 30, 1944); 122, 11–12, 14, 46 (July 7, 1944); *Paper-Maker* **107**, 4–5, 7–8, 10 (Midsummer Special, 1944) (through *Bull. Inst. Paper Chem.* **15**, 28 (Sept. 1944)).

The author, a retired director of the Shirley Institute who has been in the British research association movement since its inception in 1916, outlines the functions and organization of a research association for the benefits of the paper industry, which is intending to found a research association of its own. Reference is made to the Department of Scientific and Industrial Research and its financial relationship to the different research organizations, various procedures for raising the money, the desirability of exemption from rates and taxes, and the location of the institute. There have been research associations which had no real headquarters and which farmed out their problems to be investigated at different places, such as universities; on the whole, this policy was not a success. There is a good deal to be said for the establishment of one's own institute. The selection of the staff, with particular emphasis on the qualities of the director, is discussed rather at length. Various problems arising in connection with the staff are pointed out, such as the tempting of the staff away from the research association by an individual member firm, and the way this situation is handled. Mention is made of the activities of the Council (with the suggestion of having representatives of the trade unions), the subcommittees, and the information bureau, as well as of the participation of associated industries, often a point of bitter controversy. A form of cooperation which seems to be undergoing rapid development is that between the research associations themselves. The author found eight associations now in existence which are directly or indirectly connected with cellulose. In conclusion, he lists different projects completed at the Shirley Institute which are directly overlapping with the interests of the paper industry; unnecessary duplication of effort can be avoided through proper co-operation between the research associations.

Water Softening

Selective calcium softening for industrial water supplies. Robert T. Sheen and Everett B. Woodruff. *Ind. Eng. Chem.* **36**, 971–9 (Nov. 1944).

Many industrial water requirements can be satisfied by softening the raw water to reduce the calcium hardness in solution. This is particularly applicable to process water used for cooling purposes, and where reduction of calcium hardness and alkalinity will establish a balanced water that will not deposit calcium carbonate on heat exchange surfaces with rise in temperature. The chemical cost of reducing calcium hardness is materially less than the cost of reducing both calcium and magnesium hardness. Lime and soda softening for reduction of calcium hardness only can be controlled by pH value of the process; the pH is normally held between 9.6 and 10.2, and the exact control point is determined for the individual water. The softening process is followed by partial neutralization, either with acid or with scrubbed and purified flue gas to a controlled pH point, designed for a stable water as determined by the Langelier Index or by marble tests, or it may be further stabilized by the application of polyphosphates. Data are presented on results of this treatment at Wright Aeronautical Corporation and other industrial plants.

Water Demineralization

Demineralizing of Water for the pulp and paper industries. Eskel Nordell. *Paper Trade J.* **119**, 141–4 (Oct. 5, 1944).

Chlorides, sulphates, and sodium are neither removed nor reduced in amount by the usual water conditioning processes used in pulp and paper mills. For certain uses these impurities may be objectionable and formerly the only method known for their removal was the expensive process of distillation. Now there is available on ion exchange process for removing these impurities. The effluents furnished by this process compare very favorably in quality with distilled water and are produced at an operating cost which is usually only a small fraction of the cost of distillation. This demineralizing process is already in use in the production of dielectrics and will undoubtedly find many other applications in the pulp and paper industry.

The Institute Outlines Major Emphasis of Its Activities

DECISION to place major emphasis during 1945 on fundamental and applied research and the publication of a scientific journal was reached at a meeting of the board of directors of Textile Research Institute, Inc., held Jan. 19. This and other action growing out of the work of the special survey committee appointed last fall have been reported by the board to the members in a letter just mailed.

The special committee found wide-spread general approval of the broad five-point program by which the Institute has been pursuing its purpose. There was naturally some diversity of opinion about the relative importance and the relative urgency of its several activities. After careful consideration the board moved that the present program for applied research be pursued vigorously and expanded; that the building at Princeton be made ready at the earliest possible moment for occupancy by the Textile Foundation Research Group and by Institute research workers; and that the magazine TEXTILE RESEARCH be transformed immediately into a scientific journal. It also moved that the economic research and graduate training be pursued to the extent that funds are available.

The report to the members stated that the committee's studies and the Board's action were necessarily affected by the resignations of Fessenden S. Blanchard and Douglas G. Woolf, president and first vice-president, respectively.

Mr. Woolf informed the Board October 26, 1944, of his desire to sever his connection with the Institute not later than June 1, 1945, in order to remove his family to California and to devote his time to writing, in line with plans which he has long had in mind. Mr. Blanchard submitted his resignation to the Board on December 1, 1944, because of his desire to return from the Institute to the industrial field. Both resignations were accepted by the directors with expressions of extreme regret and of appreciation for the loyal services rendered to the Institute, and the Board asked Mr. Blanchard and Mr. Woolf to continue on the staff until June 30, 1945, the former to devote his time to membership work, and the latter to the direction of the economic study being conducted at Princeton by the Institute for the Textile Foundation. Both were asked to continue as directors.

Because of these resignations, the Board appointed Vice-President Harold DeWitt Smith as president.

The affairs of the Institute will be conducted by a plan which will afford each department a large degree of freedom, with the aid of an administrative department to serve the operating departments and handle the general administrative detail. Under this plan Dr. Henry Eyring will continue in charge of fundamental research; Giles E. Hopkins will continue in charge of applied research; Julian S. Jacobs will be in charge of publications; Mr. Woolf will devote his entire remaining time to the guidance of the present economic study; Major D. B. MacMaster will handle the details of office management and personnel; and Mr. Blanchard will devote his remaining time to membership work.

The Executive Committee now includes Harold DeWitt Smith, president; E. T. Pickard, treasurer; R. E. Rose, vice-president and chairman of the fundamental research committee; W. D. Appel, chairman of the applied research committee; H. W. Rose, chairman of the publications committee; Robert R. West, chairman of the committee on economic studies; A. L. Scott, chairman of the administrative and membership committees; and A. G. Ashcroft, J. E. Bassill, and Luther H. Hodges.

A committee composed of F. Bonnet, chairman, Earl Constantine, and R. W. Vose was appointed to study the revision of the bylaws of the Institute.

"The broad aims of the Textile Research Institute, Inc., and its ideal of service to the whole textile industry necessarily make it a living, evolving organism rather than a rigid, static structure," concluded the Board's report to the members. "The Board feels that the actions reported herein will improve the present efficiency of the Institute and the service which it is rendering to the textile industry, and will at the same time provide for further evolution and growth. The continued interest and participation of each member in guiding this evolution and growth are earnestly requested."